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Scientific and Technical Information Division
National Aeronautics and Space Administration

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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N65-24586 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AERODYNAMIC CHARACTERISTICS OF WINGS IN A SUPERSONIC FLOW IN PRESENCE OF SLIPPING
Yu. I. Krasil'nikov *In its* Eng. J. 13 Jun. 1963 p 1–10 refs (See N65-24585 14-12)

Aerodynamic characteristics and coefficients are derived for triangular, rectangular, hexagonal, and pentagonal wing structures in supersonic flow. E.E.B.

N65-24758*# Advisory Group for Aeronautical Research and Development, Paris (France).
MANUAL ON AEROELASTICITY. VOLUME VI, PART VI: COLLECTED TABLES AND GRAPHS
A. I. van de Vooren (Groningen Univ.) [1964] 145 p refs

A collection of existing numerical information on theoretical aerodynamic coefficients for a two-dimensional oscillating thin airfoil is presented. The first part describes the Theodorsen circulation function for M = 0; the second part pertains to the aerodynamic coefficients for subsonic flow (including M = 0); and the third part contains data on the aerodynamic coefficients for supersonic flow (including M = 1). A number of diagrams are presented to illustrate the trend of the coefficients when certain parameters are varied, as reduced frequency, Mach number, and ratio of control surface chord to main surface chord. G.G.

N65-24768# Rome Univ. (Italy). Aerospace Research Center
EFFECT OF A CONCENTRATED INJECTION AT THE FORWARD STAGNATION POINT OF A BLUNT BODY UNDER HYPERSONIC CONDITIONS
Ugo Ponzi and Antonio Castellani Dec. 1964 29 p refs *Its* Atti No. 9

Preliminary results are presented on the effects of high rate of injection localized at the forward stagnation point of a blunt body under hypersonic conditions. The device is envisaged as a possible mean to deform the effective shape of noses of vehicles reentering from interplanetary missions; an attempt is made to establish an analogy with spiked bodies. Pressure distribution and heat transfer data are obtained for Mach 8 and Reynolds number $0.2.10^6 \div 0.3.10^6$ and injection rates between C = 0.1 ÷ 0.6. Author

N65-24782# Melpar, Inc., Falls Church, Va.
SIMULATION OF HELICOPTER AND V/STOL AIRCRAFT. VOLUME IV: FEASIBILITY OF REDUCTION IN NUMBER OF AZIMUTH STATIONS USED IN HELICOPTER ROTOR SIMULATION Helicopter Analysis Report
Robert R. Anthony Port Washington, N. Y., Naval Training Device Center, Dec. 1964 100 p refs
(Contract N61339-1205)
(NAVTRADEVCEN-1205-4; AD-611412)

The objective is to establish the feasibility of reducing the number of azimuth stations required for rotor simulation while using the blade element approach method for computing the aerodynamic characteristics of the simulated rotor. The feasibility of the use of four azimuth stations is demonstrated, and it is shown that fixed azimuth station locations will provide the necessary accuracy. The reduced number of azimuth stations and fixed azimuth station locations with the resultant reduction in computer complexity will result in a considerable saving in hardware without sacrificing the integrity of the simulation. Author

N65-24864# Advisory Group for Aeronautical Research and Development, Paris (France).
RECENT DEVELOPMENTS IN BOUNDARY LAYER RESEARCH. PART IV
May 1965 154 p refs
(AGARDograph-97)

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1. SOME RESULTS FROM THE X-21 PROGRAM. PART 1: FLOW PHENOMENA AT THE LEADING EDGE OF SWEPT WINGS W. Pfenninger (Northrop Corp.) 47 p refs (See N65-24865 14-01)
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3. LAMINAR FLOW CONTROL AT SUPERSONIC SPEEDS E. E. Groth, S. R. Pate, and J. P. Nenni 22 p refs (See N65-24867 14-01)

N65-24865 Northrop Corp., Hawthorne, Calif. Norair Div.
SOME RESULTS FROM THE X-21 PROGRAM. PART I: FLOW PHENOMENA AT THE LEADING EDGE OF SWEPT WINGS
W. Pfenninger *In* AGARD Recent Develop. in Boundary Layer Res., Pt. IV May 1965 47 p refs (See N65-24864 14-01)

After discussing the discovery of the existence of turbulent flow at the leading edge of the X-21 wing during the early phase of the flight experiments various methods are described which reestablish laminar flow at the front attachment line of swept wings. Boundary layer suction at the wing leading edge for example through vertical nose slots was particularly effective in establishing a laminar attachment line boundary

layer at the leading edge of swept wings. In order to establish an undisturbed laminar attachment line boundary layer on swept wings it is essential to minimize disturbances which may cause turbulent bursts at the front attachment line, and to reduce the boundary layer momentum loss Reynolds number R_θ at the front attachment line to sufficiently low values ($R_\theta \leq 150$ for smooth leading edge, $R_\theta \leq 90$ to 100 with large leading edge roughness). R_θ at the front attachment line of swept wings can be reduced to such low values by means of boundary layer suction along the wing leading edge, for example through vertical nose slots, or by reducing the leading edge radius, or a combination of both methods. Wind tunnel experiments on a swept low drag suction wing in low turbulence tunnels as well as on the X-21 in flight have verified extensive laminar flow up to rather high length Reynolds numbers when an undisturbed laminar stagnation line boundary layer had been established by the above described methods. Author

N65-24866 Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Flight Dynamics Lab.
SOME RESULTS FROM THE X-21A PROGRAM. PART 2: LAMINAR FLOW CONTROL FLIGHT TEST RESULTS ON THE X-21A
L. R. Fowell and P. P. Antonatos (Northrop Corp.) *In* AGARD Recent Develop. in Boundary Layer Res., Pt. IV May 1965 83 p refs (See N65-24864 14-01)

Full scale subsonic flight tests have been made since the summer of 1963 with the X-21A laminar flow control research aircraft having swept, slotted suction wings. Results have been obtained concerning the stability, transition and stabilization of the boundary layers over the wings under adverse influences such as sweep effect, high Reynolds numbers, acoustic disturbances, surface roughness, panel vibration, atmospheric particles and meteorological influences. Successful, repeatable laminarization with predetermined suction distributions has been obtained at chord Reynolds numbers of 20×10^6 up to speeds of $M = 0.8$ and altitudes of 40 000 feet. Comparable results at chord Reynolds numbers of 30×10^6 and 40×10^6 are now being sought with investigations centering on spanwise turbulent contamination along the wing leading edge and the possible effects of internal noise from the wing suction ducting and pumping system. Author

N65-24867 Northrop Corp., Hawthorne, Calif. Norair Div.
LAMINAR FLOW CONTROL AT SUPERSONIC SPEEDS
E. E. Growth, S. R. Pate (Arnold Eng. Develop. Center), and J. P. Nenni (AFSC, Wright-Patterson AFB) *In* AGARD Recent Develop. in Boundary Layer Res., Pt. IV May 1965 22 p refs (See N65-24864 14-01)

Wind tunnel tests were conducted in the 40 inch supersonic wind tunnel at the Arnold Engineering Development Center, Tennessee, for the purpose of maintaining laminar flow at high Reynolds numbers by means of boundary layer suction. Length Reynolds numbers with laminar flow of the order of $20 \cdot 10^6$ were obtained in straight and swept wing models at Mach numbers between 2.0 and 3.5. A 6.5 foot long body of revolution provided a maximum length Reynolds number with full laminar flow of $51 \cdot 10^6$ at $M = 3.0$. The evaluated drag coefficients, which included a term corresponding to the power requirements for suction, were 60 to 80% lower than the friction coefficients of a turbulent flat plate at the same Mach and Reynolds numbers. Laminar flow control had a favorable effect on the interaction with an impinging shock wave in the sense that it delayed the beginning of boundary layer separation and transition to turbulent flow to higher shock intensities. Author

N65-24985*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LOW SUBSONIC DYNAMIC-STABILITY INVESTIGATION OF SEVERAL PLANETARY-ENTRY CONFIGURATIONS IN A VERTICAL WIND TUNNEL, PART I
Jack E. Marte and Robert W. Weaver 1 May 1965 18 p refs (Contract NAS7-100)
(NASA-CR-63117; JPL-TR-32-743) CFSTI: HC $1.00/MF $0.50

An experimental investigation of the dynamic-damping parameter, $\bar{C}m_q$, for a series of possible Mars-entry configurations was performed in the Langley 20-ft free-spinning tunnel at low subsonic velocities. Several of the tested configurations exhibited satisfactory dynamic characteristics, including the ability to recover from angular deflections up to 80°. The effect of afterbody shape and maximum angle of oscillation on the dynamic stability of certain configurations was ascertained. Drag and pitching-moment data were also obtained. Author

N65-25364# Aeronautical Research Council (Gt. Brit.)
BOW-SHOCK ESTABLISHMENT AND STAGNATION-POINT PRESSURE MEASUREMENTS FOR A BLUNT-NOSED BODY AT SUPERSONIC SPEEDS
L. Davies London, HMSO, 1965 21 p refs Supersedes NPL-AERO-1098; ARC-25794
(ARC-CD-776; NPL-AERO-1098; ARC-25794) HMSO: 4s 6d

A shock tube study was made of the bow shock establishment process in air and the pressure time profiles at the stagnation point of a blunt-nosed body in air, oxygen and argon during the establishment of supersonic flow conditions over the body. The incident shock Mach number range was $M_s = 2 \rightarrow 8$ giving a flow Mach number range behind the primary shock of $M_2 = 1 \rightarrow 2 \cdot 08$. A simple theoretical description of the establishment process agrees with experimental measurements of the bow shock position along the stagnation streamline during bow shock formation. Author

N65-25515# Joint Publications Research Service, Washington, D. C.
THE BODY OF THE DOLPHIN AS AN AIRFOIL
Yu. G. Aleyev 11 Jun. 1965 9 p Transl. into ENGLISH from Zool. Zh. (Moscow), v. 44, no. 4, Apr. 1965 p 626-630
(JPRS-30567; TT-65-31243)

Using the same procedure proposed for studying the creation of lift in heavy fish, a model was designed to demonstrate the formation of lift in a white flank dolphin. Reported are results of experiments in which the model was towed at a uniform speed of 2.0 meters/second, without pectoral fins, with pectoral fins placed at the 0° angle of attack, and with pectoral fins installed at a +10° angle of attack. It is shown that the dolphin's body creates a lift during movement in the direction of its longitudinal axis, and that the shape of the dolphin's body in motion provides for a constant formation of a certain lift which supports the animal in the suspended state. Also established is the similarity of the longitudinal vertical projection of the dolphin's body to the shapes of certain airplane wings. S.C.W.

N65-25523# Weapons Research Establishment (Australia).
AN EXAMINATION OF THE FLOW INSTABILITY ASSOCIATED WITH SPIKED BLUFF BODY CONFIGURATIONS
M. L. Robinson, B. G. Roberts, and A. M. Sayer Dec. 1964 38 p refs
(WRE-TN-HSA-101)

The flow instability characteristics of spiked bluff body configurations were studied, in the Mach range 1.6 to 2.8, as

a preliminary part of an investigation to examine an oscillatory flow regime observed with supersonic parachute configurations. In the present investigation the effects of Mach number, spike extension, and spike geometry on the boundaries of flow stability and on the characteristics of the unsteady forces were examined for a simple body consisting of a right circular cylinder fitted with a retractable spike. In the most severe condition of flow instability the instantaneous drag of the cylinder oscillated between approximately 40 and 180 percent of the mean drag. The frequency of the flow oscillation ranged from 1 to 2.5 kc/sec for the 2-in.-diam cylinder used in the tests. Author

N65-25547*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
TRANSONIC AERODYNAMIC CHARACTERISTICS OF A SATURN IB–APOLLO LAUNCH VEHICLE WITH VARIOUS UPPER-STAGE CONFIGURATIONS
C. Robert Carter Washington, NASA, Jun. 1965 26 p
(NASA-TN-D-2829) CFSTI: HC $1.00/MF $0.50

A wind-tunnel investigation was conducted in the Langley 8-foot transonic pressure tunnel to determine the transonic aerodynamic characteristics of the Saturn IB–Apollo launch vehicle with various upper-stage configurations. The tests were conducted at Mach numbers from 0.50 to 1.20, angles of attack from −6° to 18°, angles of sideslip from −4° to 10°, and Reynolds number per foot from 2.76×10^6 to 4.22×10^6. Results indicate that the normal-force contribution of the fins was approximately 50 percent of the total normal force acting on the entire vehicle. The abort configuration showed a substantial increase in axial force over the other configurations tested; however, the differences in force and moment coefficients were generally small for all configurations. Also, removal of the protuberances from the second stage (S-IV-B) had a greater effect on the normal-force and pitching-moment characteristics, as compared with the basic configuration, than did increasing the angle of the forward flare. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N65-24525# Joint Publications Research Service, Washington, D. C.
IZVESTIYA VUZov: RADIOPHYSICS, VOL. VII, NO. 6, 1964
13 May 1965 310 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 7, no. 6, Nov.–Dec. 1964 p 1021–1232
(JPRS-30060; TT-65-30983) CFSTI: $7.00

Articles are presented which discuss the generation and propagation of radio waves. For individual titles see N65-24526–N65-24558.

N65-24617# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science
A RESEARCH ON THE IMPROVEMENT OF FLYING QUALITIES OF PILOTED AIRPLANES. REDUCED STIFFNESS CONCEPT APPLIED TO ELEVATOR CONTROL SYSTEM
Jiro Horikoshi Repr. from Inst. of Space and Aeron. Sci. Rept. No. 396, v. 30, no. 5, Mar. 1965 p 115–194 refs
(ISAS-396, Vol. 30, No. 5)

Analytical investigations are made of the effect of the stiffness on the stick travel per airplane response in steady longitudinal maneuvers and on the frequency response characteristics of the airplane to stick movement during unaccelerated flight. Numerical calculations, including an analog computer analysis of the effect on the reponses stated above in the initial or transient state of longitudinal control, are made based on the data of a prototype airplane. Developments of the concept and the flight tests of the airplane are described. Both results are fairly coincident with each other, and are further backed up by experiences on this airplane and its successors. Also, investigations are made of such characteristics as might be considered to be adversely affected by the reduced stiffness. That is reduced stiffness is applicable to a subsonic airplane normally designed and not seriously affected by aerodynamic compressibility is confirmed. Author

N65-24653# Kaman Aircraft Corp., Bloomfield, Conn.
DEVELOPMENT OF A CRASHWORTHY, ARMORED, UNIVERSAL CREW SEAT FOR U.S. ARMY AIRCRAFT Final Report
George I. Hackenberger and Wallace O. Mattenson Ft. Eustis, Va., Army Transportation Res. Command, Feb. 1965 96 p refs
(Contract DA-44-177-AMC-93(T))
(USATRECOM-TR-65-2; AD-614231)

It was indicated that a universal crew seat or family of seats may be adapted for use in existing aircraft. Structural reinforcement would be required to withstand the higher seat loads, and compromises would be necessary to clear equipment and to adapt to varying structural configuration. Problems of optimum restraint, crash load attenuation, armor selection, armor coverage, mechanical system, and structural system are discussed. To achieve the safety objectives of the seat system, improvements to the standard restraint harness are recommended. Installation of the armor introduces clearance problems, especially with aft control stick travel. Resolution of this problem may require aircraft variations. Supply and maintenance of future aircraft would be enhanced by the application of an armored crashworthy crew seat. Specifications, which control the seat installation and the area around the seat, are necessary to achieve universality in these aircraft. Author

N65-24829# Bell Aerosystems Co., Buffalo, N. Y. Electromagnetic Systems Section
STUDY OF AN AUTOMATIC CARRIER LANDING ENVIRONMENT WITH THE AN/SPN-10 LANDING CONTROL CENTRAL
F. D. Powell and T. Theoclitus 1 Apr. 1965 178 p refs
(Contract NOw-63-0728-c)
(AD-463348)

To determine the effect of the automatic landing mode of AN/SPN-10 on aircraft operations and on aircraft design criteria, studies are underway to enable statistical determination of the deck contact conditions to be anticipated in automatic landing operations at sea. A mathematical model of the deck contact environment is developed and presented. Of a statistical nature, it presents formulations for the mean and standard deviation of each variable constituting the deck contact environment. Cross correlations are determined where appropriate so that the joint probability of exceeding various design boundaries may be determined. The mathematical model and the environment considered pertain to the Mode I operation of AN/SPN-10. The Mode I operation provides fully automatic control of the aircraft. Author

N65-24967# Royal Aircraft Establishment, Farnborough (England).
SONIC BANGS: A BIBLIOGRAPHY
T. I. Bell, Margaret D. Miller, and Anne E. G. Strain London, Min. of Aviation, Feb. 1965 65 p refs Supersedes RAE-LIB-BIBL-188
(RAE-LIB-BIBL-255; RAE-LIB-BIBL-188)

This annotated bibliography covers sonic boom theory and effects on structures and humans, pressure measurements from aircraft and in wind tunnels, aircraft design and operational problems, and estimation and analysis of their physical characteristics. R.N.A.

N65-24976*# National Aeronautics and Space Administration, Washington, D. C.
MATERIALS FOR THE MACH 3 SUPERSONIC TRANSPORT
George C. Deutsch [1964] 5 p Presented to the Mater. Div., Am. Ordnance Assoc., Dayton, Ohio, 23–25 Sep. 1964
(NASA-TM-X-56492) CFSTI: HC $1.00/MF $0.50

George C. Deutsch, National Aeronautics and Space Administration, discusses the importance of the Mach 3 supersonic transport in terms of commercial development, and points out the necessity of proper materials selection to offset the effects of high speed and temperature on the aircraft structure. Evaluation of skin and fuselage materials showed that a nickel alloy, INCO 718, had high strength resistance to high temperatures. Metallurgical considerations of several titaniums, superalloys, and both precipitation hardening and austenitic stainless steels, as well as selected iron, nickel, and cobalt-base superalloys, showed titanium to be the most promising material. An 8-1-1 titanium in the triplex annealed condition was found superior on the basis of tensile and notch strength at every temperature except 550° F, where the same alloy in the annealed condition excelled. Titanium alloy at stress of about 20 000 psi and temperatures of 650° F was found resistant to stress corrosion cracking for a long time, but cracked readily at about 100 000 psi. G.G.

N65-25548*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
STABILITY CHARACTERISTICS OF A TANDEM-ROTOR TRANSPORT HELICOPTER AS DETERMINED BY FLIGHT TEST
James R. Kelly and Matthew M. Winston Washington, NASA, Jun. 1965 32 p refs
(NASA-TN-D-2847) CFSTI: HC $2.00/MF $0.50

Selected, unaugmented stability characteristics of a modern tandem-rotor transport helicopter were determined by a flight investigation. The angle-of-attack instability was the predominant factor which resulted in unacceptable maneuver stability characteristics. Also present were speed and directional instabilities. Based on pilots' comments, the current V/STOL specifications concerning handling qualities appeared applicable to a helicopter of this size and configuration. Theoretical calculations of the pitch and roll damping showed good agreement with flight measurements. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N65-24447# Frankford Arsenal, Philadelphia, Pa. Research and Development Directorate
DEVELOPMENT OF GENERATOR, PROPELLANT ACTUATED, XM14
Ludwig Stiefel, George P. Catrambone, and Raymond C. Sutter Feb. 1965 49 p
(R-1751; AD-613164)

A dual gas generator was developed to provide a source of pneumatic power for operating the pre-ejection system for the B58 escape capsule. The gas produced operates a series of leg-positioning and torso-retracting mechanisms, and ultimately releases and closes the capsule doors. A high temperature-resistant propellant and igniter were used to meet extended storage and operating requirements at 200° F. The dual generator permits use of one charge to enclose the crew member in an emergency. If the emergency passes without ejection, the second generator can be fired to operate the system should this become necessary. A special shift valve arrangement, integral trap, and rupture assembly make for a high degree of reliability and safety. The results of evaluation tests showed the dual gas generator (XM14) capable of meeting the design requirements. Author

N65-24491*# Atomics International, Canoga Park, Calif.
THE EFFECTS OF RADIATION ON NICKEL–CADMIUM BATTERY ELECTRODES, I Final Report, Jun. 1963–Apr. 1965
G. R. Argue, H. L. Recht, W. A. Mc Collum, and D. E. Mc Kenzie 15 Apr. 1965 70 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950514)
(NASA-CR-62796; AI-65-66) CFSTI: HC $3.00/MF $0.75

The effects of radiation on nickel–cadmium electrodes and their magnitude are studied. It was observed that voltage–current relationships of nickel–cadmium batteries are not affected by gamma radiation in the short run. Radiation causes the cadmium electrodes to lose capacity, when undergoing charge–discharge cycling. Material is dislodged from the irradiated electrodes, with the most being lost at 100% of charge. This phenomenon may not be of great importance in commercial cells as their closely packed configuration appears to oppose this effect. Only 2 to 2 1/2 pounds per square inch were the highest observed pressures attained by cells in radiation fields. This effect is of little consequence, since cells are designed to retain gases up to 100 psig. N.E.A.

N65-24589# General Motors Corp., Anderson, Ind. Delco-Remy Div.
APPLIED RESEARCH INVESTIGATION OF SEALED SILVER–ZINC BATTERIES
J. J. Lander and J. A. Keralla Wright-Patterson AFB, Ohio. AF Aero Propulsion Lab., 3 May 1965 51 p
(Contract AF 33(657)-10643)
(APL-TDR-64-85, Suppl. 1; AD-463102)

The addition of LiOH to regular 45% KOH electrolyte has no apparent effect on prolonging cycle life at 25% depth of discharge. Cells containing 45% NaOH electrolyte reached 2800 cycles before failure occurred by internal shorts. Cells containing various polypor membranes did not prolong cycle life at 25% depth of discharge. Cells containing separation of low density polyethylene radiated high graft reached over 2700 cycles at 25% depth of discharge without failure. Cells containing experimental cellulosic casing material of small pore size with silver ions did not prolong cycle life at 25% depth of discharge. Author

N65-24686# Tohoku Univ., Sendai (Japan).
THEORETICAL CONSIDERATION ON ENERGY CONCENTRATION RATIO, CONCENTRATION EFFICIENCY AND OBTAINABLE TEMPERATURE OF SOLAR FURNACE. I: FLAT TARGET
Osamu Kamada *In its* Bull. of the Res. Inst. for Sci. Meas., Vol. 12, No. 1 Nov. 1963 p 30–44 refs (See N65-24683 14-15)

By taking the brightness distribution of the solar disk into consideration, the characteristics of a parabolic-type solar furnace were theoretically treated. The energy concentration ratio, the concentration efficiency, and the maximum temperature obtainable for the flat targets were calculated for the furnaces with different aperture ratios. These were then compared with the results obtained by assuming that there was a uniform brightness distribution of solar disk. Author

N65-24723*# Pennsylvania State Univ., University Park. Systems and Controls Lab.
SIGNAL NOISE IN PURE FLUID AMPLIFIERS Research Report No. 1
J. C. Tamulis Apr. 1965 16 p refs
(Grant NGR-39-009-023)
(NASA-CR-62882) CFSTI: HC $1.00/MF $0.50

A literature search and the formulation of a program relative to studies of signal noise in pure fluid amplifiers has been completed, and two large-scale fluid amplifiers and a deep water table for experimental use have been constructed. A prototype pneumatic motor was constructed that uses flexible bags instead of bellows for the conversion of pulse pressures. A computer-aided investigation of a hydraulic stepper, utilizing a cam groove to produce a net increment of linear or rotary output movement from the reciprocating motion of the cam, proved its feasibility for use as an actuator in remote control and/or automatic control systems. Analytical and phase plane studies of hysteresis-caused instabilities in closed loop control systems showed that introduction of a switching logic network restores the stability. Other studies were *Dynamics of Fluid Transmission Lines; Experimental High Performance Electric Servomotor with Minimum Weight and Size; Fluid Amplifiers and Stability; Time-Delay Characteristics in Systems Employing Vortex Devices;* and *Steam-to-Air Converter.* G.G.

N65-24772*# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
FLYWHEEL STABILIZED, MAGNETICALLY TORQUED ATTITUDE CONTROL SYSTEM FOR METEOROLOGICAL SATELLITES, 25 May–13 Oct. 1964
Washington, NASA, May 1965 222 p refs
(Contract NAS5-3886)
(NASA-CR-232) CFSTI: HC $6.00/MF $1.25

Work was directed toward developing an attitude-control system for spacecrafts which perform a meteorological mission; however, the design study is applicable to a wide range of missions. Wherever possible, the fundamental design procedures are included in each subsystem comprising the whole. Application of these design procedures was used to define the method for attitude control of the 500-lb spacecraft, which can be considered an example on which the design procedures were exercised. The control system studied comprises three major and nearly independent subsystems. The first will provide control about the roll and yaw axes of the spacecraft by magnetic torquing nearly identical to that planned for the TIROS Wheel spacecraft. Principles of this techniques are referred to as quarter-orbit magnetic attitude control (QOMAC). The second major subsystem will provide control about the pitch axis of the spacecraft. This control will be effected through a closed-loop system, comprising a simple IR bolometer, compensation networks, and a torque motor which exchanges momentum between a flywheel mounted on an axis parallel with the spacecraft's pitch axis and the main spacecraft pitch-axis momentum by an additional magnetic torquing technique. Author

N65-24805# Lenkurt Electric Co., Inc., San Carlos, Calif.
INTERCONNECTING NETWORK OA-7181(XW-1)/FCC-17, OA-7182(XW-1)/FCC-17 AND OA-7183(XW-1)/FCC-17 (GROUP INTERCONNECT PANEL), PHASE B Final Engineering Report
Forrest N. Easley and C. Dean Charrier 30 Oct. 1964 31 p refs
(Contract AF 30(635)-11188)
(RADC-TDR-64-371, Vol. II; AD-461673)

Testing of equipment designed and developed for use with Multiplexer Set AN/FCC-17 to provide interconnecting capability between channel groups is summarized. It was concluded that the equipment is highly reliable and fully compatible with Multiplexer Set AN/FCC-17. Author

N65-24843*# Astropower, Inc., Newport Beach, Calif.
INORGANIC ION EXCHANGE MEMBRANE FUEL CELL Quarterly Progress Report, Period Ending 10 Apr. 1965
C. Berger, M. P. Strier, and G. Belfort Apr. 1965 50 p refs
(Contract NAS3-6000)
(NASA-CR-54379; SM-46221-Q3) CFSTI: HC $2.00/MF $0.50

A 60% improvement in fuel cell performance was achieved by two independent approaches. In the first approach, a compact fuel cell was designed on the basis of practical operating conditions and substantiated by heat and mass transfer analysis. In the second approach, various exploratory tests had suggested the design of a membrane-catalyst configuration wherein the catalyst was impregnated in the membrane to only a very small depth. It has been established that hydrogen–oxygen fuel cells can be operated at temperatures as high as 148° C. Temperature does not appear to have a significant effect on fuel cell performance in the 65° to 120° C range because the conductivity of the membrane remains essentially invariant with increasing temperature under these conditions. The details of these studies are given as well as indications that still higher performance levels could be attained. N.E.A.

N65-24850# Oklahoma State Univ., Stillwater. School of Electrical Engineering
PROCEEDINGS OF THE 2ND ANNUAL ENERGY CONVERSION AND STORAGE CONFERENCE, OCT. 12–13, 1964
Bill Linville, ed. [1964] 74 p refs Available from Oklahoma State Univ. $5.00

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8. NEED FOR BASIC RESEARCH IN THE FIELD OF ENERGY CONVERSION L. J. Long (Army Eng. and Dev. Labs.) 6 p refs (See N65-24858 14-03)

9. PROBLEMS AND PROGRESS IN CONTROL OF THERMONUCLEAR FUSION FOR ELECTRIC POWER PRODUCTION A. A. Dougal (Tex. Univ.) 8 p refs (See N65-24859 14-03)

10. THE FEASIBILITY OF MHD POWER GENERATION W. S. Emmerich (Westinghouse Elec. Corp.) 6 p (See N65-24860 14-03)

N65-24851 Oklahoma Gas and Electric Co., Oklahoma City.
STORAGE AS AN ECONOMIC ALTERNATIVE FOR CONVENTIONAL PEAKING CAPACITY
Ralph E. Thornton and Tom Hoke *In* Okla. State Univ. Proc. of the 2nd Ann. Energy Conversion and Storage Conf., Oct. 12–13, 1964 [1964] 3 p refs (See N65-24850 14-03) Available from Okla. State Univ.: $5.00

To determine the investment that could be justified in an electrolysis-fuel cell energy storage system, it is necessary to consider a specific purpose. The parameters of an energy storage system are therefore developed for a specific situation which is representative of the Southwest. The cost of a conventional peaking plant to serve the same end then provides a basis for comparison. The actual customer characteristics are used in the analysis. Electric utilities, however, are unique entities that resist generalization. The most economical method of adding capacity to a particular system depends upon many variables which include rate of growth, types of existing units, fuel costs, and financing. The interaction of these variables makes necessary the development and analysis of many plans in order to assure the most economical expansion of an existing electric system. Large peaking units were not found to be an economical way of expanding the situation considered. For example, a 250-MW reheat steam unit with a heat rate of 9500 Btu/kWh can be built for $80/kW. This can be shown to save $20/kW of added investment over the peaking plant. E.E.B.

N65-24852 Union Electric Co., St. Louis, Mo.
ENERGY STORAGE BY HYDRAULIC MEANS. THE TAUM SAUK PROJECT
George P. Gamble *In* Okla. State Univ. Proc. of the 2nd Ann. Energy Conversion and Storage Conf., Oct. 12–13, 1964 [1964] 14 p refs (See N65-24850 14-03) Available from Okla. State Univ.: $5.00

The forces and factors which blended together to increase the flexibility and improve the economics of power supply facilities, by including elements which make use of energy conversion and storage by hydraulic means, are covered. However, there are many variations in physical and economic requirements. Although the broad principles discussed apply to most pure pumped hydrostorage installations, they do not necessarily apply to all situations and to many combination projects which simply incorporate pumped storage as one of their features. There are a number of ways besides the use of conventional storage hydroelectric plants and pumped hydrostorage to provide new generating capacity especially suited to peaking. Gas turbines, diesel packages, and steam units built specifically for low load factor service have similar qualifications. Rapid starting, reduced capital cost, high energy cost, low manpower cost, and extensive use of automation are the hallmarks of these approaches, as well as of pumped hydrostorage. Firm hydroelectric capacity made possible by pumped hydrostorage is especially suited for peaking service on temperature sensitive electric systems. E.E.B.

N65-24853 Westinghouse Electric Corp., Pittsburgh, Pa. Electric Utility Engineering
ECONOMICS OF ENERGY STORAGE
James E. O'Neil *In* Okla. State Univ. Proc. of the 2nd Ann. Energy Conversion and Storage Conf., Oct. 12–13, 1964 [1964] 8 p refs (See N65-24850 14-03) Available from Okla. State Univ.: $5.00

Pumped storage hydro requires a higher capital cost than most thermal peaking plants, but it also offers effective fuel costs that can be only 50% higher than the most efficient plant on an electric system. The interplay of these two factors is considered. It was concluded that there is an increased need for peaking generation. Power pooling can provide temporary relief of peaking requirements by allowing the use of larger and more efficient base-load machines, by providing temporary excess reserve, and by improving load factors. However, power pools can justify 10% to 20% of their generating capacity even when base-load units cost as low as $95 to $115/kW installed. Stored energy from pumped storage hydro will be used to a lesser extent than previously anticipated because of advances in gas turbines with substantially lower installed cost. Further, besides the lower installed costs, the gas turbine offers site flexibility, fewer regulatory problems in site approval, and firm capability which is not dependent on the availability of stored water. E.E.B.

N65-24854 Allis-Chalmers Mfg. Co., Milwaukee, Wis. Electrical Transmission and Distribution Div.
INVERSION IN THE MEGAWATT RANGE
J. H. Harlow *In* Okla. State Univ. Proc. of the 2nd Ann. Energy Conversion and Storage Conf., Oct. 12–13, 1964 [1964] 7 p refs (See N65-24850 14-03) Available from Okla. State Univ.: $5.00

The use of one or more three-phase, full wave Graetz bridges, one of the most practical for high-voltage, high-power applications, is discussed. Such a converter is illustrated. The transmission of electric power by direct current is carried out in numerous industrial applications, and a few utility applications are in service. The basic methods have been proven for point-to-point transmission. A major breakthrough for electric power conversion would be the development of solid state devices rated in the megawatt range. Improved converter control refinements are required for applications where there are multiterminal direct current systems. Also, fuel cells in central station supply offer unique possibilities for direct current. Inversion is necessary but the greater efficiency of direct current transmission will tend to brighten the prospect of this source of power transmission. E.E.B.

N65-24855 Oklahoma State Univ., Stillwater. School of Electrical Engineering
FUEL CELL RESEARCH AT OKLAHOMA STATE UNIVERSITY
H. Jack Allison *In its* Proc. of the 2nd Ann. Energy Conversion and Storage Conf., Oct. 12–13, 1964 [1964] 6 p ref (See N65-24850 14-03) Available from Okla. State Univ: $5.00

The development of a fuel cell which acts reversibly as an electrolysis cell, has electrodes which will function at pressures as high as 3000 psi, and with design characteristics which will allow units to be mass produced is discussed. Also, the construction and analysis of a fuel cell which operates without a conventional catalyst or electrolyte are presented. Comparison is also made of these two fuel cell developments with a conventional fuel cell model. In the fuel cell development which eliminates the use of the catalyst and electrolyte, the

catalyst of the conventional cell is replaced by a source of radiofrequency excitation, and the function of the electrolyte is replaced by an intense transverse magnetic field. A significant advantage of this system is that the artificial electrolyte and catalyst are subject to precise mathematical analysis.
E.E.B.

N65-24856 Eagle-Picher Co., Joplin, Mo. Couples Dept.
THE ZOX SYSTEM
Earl B. Cupp *In* Okla. State Univ. Proc. of the 2nd Ann. Energy Conversion and Storage Conf., Oct. 12–13, 1964 [1964] 2 p (See N65-24850 14-03) Available from Okla. State Univ.: $5.00

A fuel cell using metallic zinc as the fuel and gaseous oxygen as the oxidizer is described. It is a hybrid system with some characteristics of the conventional silver–zinc battery and some characteristics of a low temperature hydrogen–oxygen fuel cell. Also, it is closely related to the zinc-air cell but uses pure oxygen instead of air and is designed so that it can be discharged at relatively high currents. Utilization of oxygen appears to be 100% and utilization of zinc is at least 70% at low discharge rates. The energy output of the silver–zinc battery is about 100 W-hr/lb. At similar discharge rates, the system described is capable of providing from 150 to 200 W-hr/lb. The cells are fabricated with the zinc fuel electrode in a charged state and activated with electrolyte just prior to use. The system is handled as a primary battery with the exception that oxygen must be supplied before power can be obtained.
E.E.B.

N65-24857 Pratt and Whitney Aircraft, East Hartford, Conn.
INTEGRATING THE FUEL CELL POWERPLANT INTO THE ELECTRIC UTILITY INDUSTRY
Ronald J. Borrup *In* Okla. State Univ. Proc. of the 2nd Ann. Energy Conversion and Storage Conf., Oct. 12–13, 1964 [1964] 9 p (See N65-24850 14-03) Available from Okla. State Univ.: $5.00

Many of the factors which must be considered for integrating the fuel cell into electric utility industry use are discussed. Such factors are strongly interrelated requiring broad systems analysis to provide the best basis for decision. Also, an insight into the problems facing the fuel cell powerplant manufacturer is provided. The fuel cell's ability to compete with other energy sources is considered in terms of the specific cost in $/kW, specific weight in lbs/kW, and the specific volume in cu ft/kW of the overall system. Further, the cost and type of fuel are considered. It is highly possible that economic usage of the fuel cell by the electric power industry can occur only after use of low cost hydrocarbon fuels becomes practical.
E.E.B.

N65-24858 Army Engineer Research and Development Labs., Fort Belvior, Va.
NEED FOR BASIC RESEARCH IN THE FIELD OF ENERGY CONVERSION
Louis J. Long *In* Okla. State Univ. Proc. of the 2nd Ann. Energy Conversion and Storage Conf., Oct. 12–13, 1964 [1964] 6 p refs (See N65-24850 14-03) Available from Okla. State Univ: $5.00

The vital need for basic research in the field of electric energy conversion is stressed. It is urged that much stronger emphasis be placed upon supporting research directed toward obtaining information regarding the fundamental electromagnetic conditions and mechanisms involved in direct energy conversion.
E.E.B.

N65-24859 Texas Univ., Austin. Dept. of Electrical Engineering
PROBLEMS AND PROGRESS IN CONTROL OF THERMONUCLEAR FUSION FOR ELECTRICAL POWER PRODUCTION
Arwin A. Dougal *In* Okla. State Univ. Proc. of the 2nd Ann. Energy Conversion and Storage Conf., Oct. 12–13, 1964 [1964] 8 p refs (See N65-24850 14-03) Available from Okla. State Univ.: $5.00

The basic principles of controlled thermonuclear fusion are summarized. Also, ion cyclotron resonances and waves in thermonuclear plasmas, and theta-pinch thermonuclear plasmas are discussed as representative of present day research. Further, the Faraday rotation method of infrared maser diagnostics is presented. Comparison of fusion approaches of the theta-pinch, pyrotron, stellarator, ion injection, and linear pinch methods are compared. Results show that the theta-pinch is an order of magnitude better than other approaches. Theta pinches are the best established means of producing plasmas with kilovolt energies, with at least short term stability, and with a plasma pressure comparable to that of the magnetic field. In the theta-pinch, the plasma is heated and contained by a longitudinal magnetic field produced by a high-current single turn coil.
E.E.B.

N65-24860 Westinghouse Electric Corp., Pittsburgh, Pa.
THE FEASIBILITY OF MHD POWER GENERATION
W. S. Emmerich *In* Okla. State Univ. Proc. of the 2nd Ann. Energy Conversion and Storage Conf., Oct. 12–13, 1964 [1964] 6 p (See N65-24850 14-03) Available from Okla. State Univ.: $5.00

The principle of the magnetohydrodynamic (MHD) generator and average characteristics of such generators are presented. The most noteworthy experimental results was 11 MWe generated during 55-sec runs and 10 KWe during 1-hour runs, with open cycle generators. Experiments with closed cycle generators are promising but are not as advanced as those with the open-cycle types. An experimental MHD generator is shown capable of developing 10 KW. The combustion system uses fuel oil and oxygen and was designed on the basis of jet-engine principles. The system operated for about 1 hr at which time the oxygen supply was exhausted. The experiment confirmed the MHD laws used to design the generator and established sufficient evidence for extrapolation of the design to generators of much larger size.
E.E.B.

N65-24874*# Electro-Optical Systems, Inc., Pasadena, Calif.
ANALYSIS OF ANCILLARY EQUIPMENT FOR SOLAR-THERMIONIC SYSTEM. VOLUME II: TECHNICAL BACKGROUND Final Report
10 Mar. 1965 273 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950699)
(NASA-CR-62977; EOS-4326, Final) CFSTI: HC $6.00/MF $1.50

An analysis of instrumentation required for operation of the solar thermionic system and the types of sensors which would be applicable, is presented. Considered are those instruments which are needed for control of the system and which are useful for monitoring performance and/or variation of operational conditions by ground command. Discussed are instrumentation required for the generator and concentrator, strain and thermal instrumentation, and reflectance and angular error instrumentation. Three types of temperature sensors were considered for use in system measurements in the range of 0° to 800°C: wire-type resistance sensors, thermocouples, and thermistors. Results show that the wire-type resistance sensors were best suited for the system. Data

are also given on methods of measuring emitter temperature, solar flux control, cesium reservoir control, power conditioning and control, configuration and performance data in respect to the power conditional equipment for a typical solar thermionic power system, recommended programs for the development of systems hardware, space environmental effects on reflective surfaces, and the physical properties of mirror-substrate materials. S.C.W.

N65-24894*# Marine Engineering Lab., Annapolis, Md.
CHARGE-CURRENT CONTROL CIRCUIT FOR NICKEL-CADMIUM CELLS WITH CONTROL ELECTRODES
P. P. M. Liwski Apr. 1965 19 p
(NASA Order S-12730-G)
(NASA-CR-62959; MEL-25/65) CFSTI: HC $1.00/MF $0.50

A circuit to control charge current entering nickel–cadmium cells with control electrodes ("three-terminal" cells) was developed for use in systems requiring minimum space and weight with optimum control satellite applications. The potential on the third (control) electrode of a cell becomes input to determine time and manner of charge-current change. Author

N65-24922*# Ryan Aeronautical Co., San Diego, Calif.
THE DEVELOPMENT OF DEPLOYABLE SOLAR ARRAYS, PHASE I Summary Report
A. C. Maier and B. Lake 15 Oct. 1964 96 p *Its* Rept.-64B119
(Contract NAS5-3987)
(NASA-CR-62978)

Design and test investigations selected a segmented beam concept which fulfills Goddard's design parameters. Engineering drawings, which present detailed solutions to the problems of construction, packaging, deployment, and rigidization were produced. A working 1/2-scale model has been constructed to demonstrate the concept. Further investigation indicates recommended variations of the basic concept, which uses available volume inside the shroud to a greater advantage than the present envelope, and could be better adapted for larger arrays. Author

N65-24980*# Westinghouse Electric Corp., Newbury Park, Calif. Astroelectronics Dept.
MOLECULAR POWER SUPPLY Third Quarterly Report, Nov.–Jan. 31, 1963
31 Jan. 1963 20 p
(Contract NAS7-100)
(NASA-CR-63114) CFSTI: HC $1.00/MF $0.50

Further design work on the interconnection pattern showed it is not possible to perform all required connections without 0.0005-inch lines in some places. It was felt that the increased resistance in the lines, particularly the ground, and decrease in reliability was inadvisable. The basic logic element layout was redesigned to (1) increase the number of crossover tubs, and (2) optimize the shape and location of existing ones for connections required. Using this new design, a much more satisfactory layout was designed. The feasibility of the NPN portion of the output switches has been proven, with satisfactory devices fabricated and tested. The PNP portion has been designed. Finally, the package design is complete. Author

N65-24986*# Naval Ammunition Depot, Crane, Ind.
[SPACE CELL TEST PROGRAM] Monthly Progress Report, Period Ending 30 Nov. 1964
[1964] 109 p Sponsored by NASA
(NASA-CR-63095) CFSTI: HC $4.00/MF $0.75

Data on 99 cell packs undergoing orbital cycling of 90 minutes to 24 hours preceded by capacity tests, are presented. Test parameters included the ambient temperatures, the voltage limits per pack on charge, and the depth of discharge of nickel–cadminum (10-cell packs), nickel–cadmium (5-cell packs), silver–cadmium (10-cell packs), and silver–zinc (5-cell packs). G.G.

N65-25193# Texas Instruments, Inc., Dallas.
EXTENDED MOLTEN-CARBONATE FUEL CELL SYSTEM PROGRAM, TASKS II, III, AND IV Final Technical Report, 1 Jul. 1964–15 Feb. 1965
B. H. Barbee, F. L. Gray, J. F. Haefling, T. N. Hooper, and B. R. West 12 Mar. 1965 46 p
(Contract DA-44-009-AMC-54(T))
(TI-08-65-40; AD-463008)

The specific objectives were to develop a modular arrangement of cells utilizing low cost materials, amenable to large-scale manufacture, and suitable for construction of much larger units; to obtain design data for the components of a complete system utilizing the developed design; and to carry out reliability testing of the molten-carbonate fuel cell modules developed. The following achievements resulted: (1) Screen structures economic to fabricate as electrodes were found to provide good performance in molten-carbonate cells. (2) Particulate magnesia was found to be a simple means of providing separator electrolyte support. (3) Placing the cells in series was demonstrated. (4) Heat management by oxidant gas recirculation was shown to be a low-loss technique in total systems. (5) Availability of suitable heat exchangers and blowers for the system was proved. Author

N65-25212# Ford Instrument Co., Long Island City, N. Y.
LO-TEMP THERMIONIC PLASMA STUDY Yearly Report
L. L. Haring et al Dec. 1964 74 p refs
(Contract Nonr-3416(00))
(AD-459608)

Using a sequence of single cylindrical diodes, the effect of processing variables on collector performance was evaluated. The control of the rate of dispenser emitter evaporation by vacuum preaging techniques was found to be the most significant factor in providing a surface of suitable work function and electrical conductivity. In addition, a cylindrical multiple collector comparator diode provided for substrate comparison and dynamic evaluation of the collector work function during early life. The experimental data generated by both diode types lead to the conclusion that the collector surface is one of an "n" type semiconductor consisting of a constantly replenished layer of barium oxide doped with barium. This surface has a measured work function (1.4 eV) which is definitely lower than the normal families of cesium-covered refractory metals. Consequently, this is one of the significant contributing factors in generating the superior performance of these diodes in the low and moderate temperature ranges. Author

N65-25272*# National Aeronautics and Space Administration, Washington, D. C.
ELECTRICAL POWER GENERATION SYSTEMS FOR SPACE APPLICATIONS
1965 42 p Prepared jointly with Dept. of Defense
(NASA-SP-79) CFSTI: HC $2.00/MF $0.50

An authoritative and current review of the Nation's space power program is discussed with the primary emphasis on assessing the current and predicted state of the art of solar, chemical, and nuclear systems. This study is based on 20 technical papers and comments prepared by authorities from industry, universities, and the Government. The findings of the authorities were integrated with those presented in the technical papers reviewed, and attention is focused on significant problems, conclusions, and recommendations. R.W.H.

N65-25404*# Cook Electric Co., Dayton, Ohio. Inland Testing Labs.
TESTING AND EVALUATION OF NICKEL–CADMIUM SPACECRAFT-TYPE CELLS Final Technical Report
I. F. Luke and E. A. Roeger [1965] 145 p
(Contract NAS5-1048)
(NASA-CR-63181) CFSTI: HC $4.00/MF $1.00

The testing and evaluation of nickel–cadmium battery cells are summarized. The evaluation was not completed since only about 33% of the test cells had failed. There were no failures as a result of vibration, shock, or acceleration tests. The cells operated normally during and after each of these tests. No significant conclusions were made concerning the cycle-life tests, also because of the limited number of failures. Generally, the number of cycles successfully completed before failure was dependent on both temperature environment and depth of discharge. E.E.B.

N65-25406*# Electro-Optical Systems, Inc., Pasadena, Calif.
ANALYSIS OF ANCILLARY EQUIPMENT FOR SOLAR-THERMIONIC SYSTEM, VOLUME I Final Report
10 Mar. 1965 33 p Prepared for JPL
(Contracts NAS7-100; JPL-950699)
(NASA-CR-63184; EOS-4326, Final) CFSTI: HC $2.00/MF $0.50

Analysis results for solar-thermionic systems are summarized, and a series of recommended programs for the development of high efficiency, reliable, solar-thermionic systems is presented. Weight and efficiency numbers of the system components were based on reasonable projections of the state of the art, and expressions for the concentrator absorber efficiency are shown as a function of cavity temperature and distance from the sun. Beryllium was evaluated as feasible material for generator support. Efficiency curves were derived for converters operating at 15, 20, and 25 watts/cm^2 at 0.7 volts and emitter temperatures of 1500° to 1800° C. The power and efficiency curves of a five-converter generator were established by testing. All instruments which are needed for the control and monitoring of the generator were examined for their feasibility, and a block diagram of the recommended power conditioning and control subsystems is presented. Also included is a list of general considerations for the integration of a solar-thermionic system in practical vehicles and missions. G.G.

N65-25462*# Clevite Corp., Cleveland, Ohio. Electronic Research Div.
DEVELOPMENT OF THIN FILM CdS PHOTOVOLTAIC CELLS Second Quarterly Report, 15 Jan.–14 Apr. 1965
F. A. Shirland, F. Augustine, and W. K. Bower 12 May 1965 36 p refs
(Contract NAS3-6461)
(NASA-CR-54413) CFSTI: HC $2.00/MF $0.50

Improvements were effected in making frontwall plastic substrate cells. Improved conductive coating for the plastic developed, led to higher efficiencies. Three cells, of 3 in. × 3 in., with initial efficiencies over 4% were obtained. Average efficiency of the 22 large area plastic substrate cells fabricated was 3.0%. Six of eleven smaller area cells fabricated had more than 5.0% efficiency, and two cells of 7 cm^2 area had 5.8% efficiency. That there is a definite area effect on these cells which shows up in the short circuit current density is evident. This effect was found to result from some unidentified aspect of the processing of the cell rather than from the area per se. A study of the effect of various CdS doping levels on the characteristics of the evaporated films was completed. Composition and evaporation parameters for each layer of the double layer film can now be specified. Study of the effect of the thickness of each layer on cell characteristics was started. Tooling for the evaporation of very thin films was completed and proven in. Additional test data from the vacuum thermal cycling of various design film cells were obtained. The frontwall metal substrate cells with conductive epoxy cemented grids showed no shorting, but did degrade saverely, in a pattern associated with moisture or impurity contamination. Two plastic substrate cells, while of low efficiency initially, have shown no shorting or appreciable degradation up to 1500 cycles. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology.

N65-24417# Oregon State Univ., Corvallis. Science Research Inst.
EFFECTS OF HYDRAZINES ON THE METABOLISM OF CERTAIN AMINES AND AMINO ACIDS Final Report, 1 Jun. 1963–30 Jun. 1964
D. J. Reed, F. N. Dost, and C. H. Wang Wright-Patterson AFB, Ohio, AMRL, Dec. 1964 44 p refs
(Contract AF 33(657)-11757)
(AMRL-TR-64-113; AD-610570)

Effects of intraperitoneally administered simple hydrazines upon the metabolism of amines and amino acids in rats were examined. Unsymmetrical dimethylhydrazine (UDMH), monomethylhydrazine (MMH), and hydrazine strongly inhibited oxidation of putrescine-1, 4-C^{14} (1,4-diamino butane) and methylamine-C^{14} to $C^{14}O_2$. The MMH caused a virtually complete inhibition of monoamine oxidase activity in vivo, but inhibition by UDMH and hydrazine was limited. In vivo and in vitro diamine oxidase activity was heavily suppressed by all three hydrazines. A possible difference between the enzyme systems which metabolize methylamine and putrescine is indicated. The metabolism of varied oral and intraperitoneal doses of L-glutamic acid-1-C^{14} was inhibited by hydrazine, but not by UDMH or MMH. In vivo decarboxylation of trace amounts of 3,4-dihydroxyphenylalanine-1-C^{14} was not affected by any of the three hydrazines. It was also indicated that UDMH may cause a substantial loss of gastric motility. Author

N65-24435# Joint Publications Research Service, Washington, D. C.
VESTNIK OF THE USSR ACADEMY OF MEDICAL SCIENCES, VOL. XX, NO. 2, 1965
27 May 1965 161 p refs Transl. into ENGLISH from Vestnik Akad. Med. Nauk SSSR (Moscow), v. 20, no. 2, 1965 97 p
(JPRS-30288; TT-65-31100) CFSTI: $5.00

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1. MODERN TEACHING ON CHRONIC GASTRITIS S. M. Ryss p 1–13 refs
2. EXTRABULBAR CONSTRICTIONS OF THE DUODENUM IN ADULTS V. Kh. Vasilenko, M. M. Sal'man, and N. A. Rabukhina p 14–23 refs
3. CERTAIN PROBLEMS CONCERNING THE PATHOGENESIS OF DUODENAL ULCER B. Ye. Votchal, A. S. Belousov, and G. L. Levin p 24–30 refs
4. VITAMIN B_{12} ABSORPTION IN PATIENTS WITH GASTRIC CARCINOMA AND A RESECTED STOMACH A. Z. Tsfasman p 31–36 refs

5. THE ACTIVITY OF RENIN AND STATE OF THE JUXTAGLOMERULAR APPARATUS IN THE KIDNEYS OF PATIENTS WHO DIED OF HEPATIC CIRRHOSIS WITH ASCITES AND CONGESTIVE CARDIAC INSUFFICIENCY Yu. A. Serebrovskaya, A. M. Vikhert, G. I. Koropova, A. F. Ushkalov, and I. A. Uchitel' p 37–51 refs

6. THE PROBLEM CONCERNING THE MECHANISM OF CARDIAL FUNCTION A. L. Grebenev p 52–56 refs

7. EFFECT OF VEGETOTROPIC SUBSTANCES (ATROPINE, MORPHINE, NICOTINE) ON THE DUODENAL MOTOR FUNCTION IN PATIENTS WITH PEPTIC ULCER O. L. Kolosova p 57–64 refs

8. PERIODIC MOTOR ACTIVITY OF THE SMALL INTESTINE IN ITS NORMAL AND INFLAMED STATE V. G. Khlystov p 65–72 refs

9. ENTEROKINASE AND ALKALINE PHOSPHATASE CONTENT IN THE PURE SECRETION OF THE JEJUNUM IN HEALTHY INDIVIDUALS M. N. Vlasova p 73–78 refs

10. MORPHOLOGICAL AND FUNCTIONAL CHANGES IN THE STOMACH DURING ITS PRETUMOROUS STATES Ts. G. Masevich p 79–88 refs

11. STATE OF THE CARDIOVASCULAR SYSTEM IN CORONAROGRAPHY UNDER CONDITIONS OF A TRANSITORY ACETYLCHOLINE-INDUCED CARDIAC ARREST L. C. Zingerman, B. M. Kogan, Ya. B. Kurilovich, A. P. Parfenov, and Ye. P. Pospelova p 89–95 refs

12. INHALATION RADIOCARDIOGRAPHY AND ITS DIAGNOSTIC VALUE F. F. Vysokiy p 96–113 refs

13. THE ROLE OF ELECTROLYTES IN CARDIAC PATHOLOGY V. M. Bogolyubov p 114–123 refs

14. DIAGNOSTIC POSSIBILITIES OF THE APEX CARDIOGRAM M. Ye. Slutskiy p 124–130

15. ACUTE GASTROINTESTINAL HEMORRHAGES K. I. Shirokova p 131–142 refs

16. THE PROBLEM OF INVESTIGATION OF MUCOID SUBSTANCES IN THE STOMACH G. V. Tsodikov p 143–155 refs

N65-24437# Joint Publications Research Service, Washington, D. C.

VESTNIK OF THE USSR ACADEMY OF MEDICAL SCIENCES, VOL. XX, NO. 3, 1965

28 May 1965 155 p refs Transl. into ENGLISH from Vestnik Akad. Med. Nauk SSSR (Moscow), v. 20, no. 3, 1965 p 3–95

(JPRS-30306; TT-65-31111) CFSTI: $5.00

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2. ON THE NOSOLOGY AND CLINICAL VARIANTS OF KLINEFELTER'S DISEASE A. M. Ponomarenko p 14–22 refs

3. ON THE QUESTION OF KLINEFELTER'S SYNDROME G. G. Mirzayants, I. V. Veshneva, G. S. Zefirova, and M. B. Khaykina p 23–28 refs

4. THE DETECTION OF TWO CELL LINES IN BONE MARROW AND PERIPHERAL BLOOD CULTURES IN CHRONIC MYELOLEUKEMIA Ye. K. Pyatkin and G. G. Poroshenko p 29–35 refs

5. ON THE ETIOLOGY OF CERTAIN ENDOCRINE DISEASES (ADRENALS AND THYROID GLAND) B. N. Klosovskiy, M. F. Yankova, and A. V. Tambovtseva p 36–55 refs

6. SOME CLINICO-GENETIC FORMS OF DIABETES MELLITUS I. S. Liberman p 56–65 refs

7. ON THE NATURE OF HEREDITY IN THE PROGRESSIVE MUSCULAR DYSTROPHIES AND THE ROLE OF ENVIRONMENTAL FACTORS A. I. Lepukal'n p 66–72 refs

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9. RADIATION ASPECTS OF GENETIC CELL DIFFERENTIATION AND THE PROBLEM OF MALIGNANT GROWTHS N. P. Dubinin and I. L. Gol'dman p 80–102 refs

10. HEREDITARY CHANGES DUE TO ENZYMES I. A. Rapaport p 103–111 refs

11. THE GENETIC ACTIVITY OF THALIDOMIDE (THE IMIDE OF N-PHTHALYGLUTAMIC ACID) L. M. Filippova p 112–118 refs

12. A METHOD FOR THE PRELIMINARY EVALUATION OF THE TERATOGENIC ACTIVITY OF PHARMACOLOGICAL PREPARATIONS USING CHICK EMBRYOS P. N. Aleksandrov, V. A. Bodganova, A. I. Ivanov, A. P. Skoldinov and A. M. Chernukh p 119–124 refs

13. GENETIC RESEARCH IN THE USA B. V. Konyukhov p 125–130

14. MEDICAL GENETICS AND THE 11TH INTERNATIONAL GENETIC CONGRESS Ye. F. Davidenkova p 131–138

15. RESULTS OF A SYMPOSIUM ON THE BASIC DIRECTIONS IN SOVIET RHEUMATOLOGY (AN ENCOUNTER WITH RHEUMATOLOGISTS FROM THE USA) A. A. Tustanovskiy and A. N. Orlova p 139–151

N65-24455# Brooks Hospital, Inc., Brookline, Mass.

THE REGULATION OF PHOTOSYNTHETIC ACTIVITY IN *CHLAMYDOMONAS REINHARDI* Final Technical Report

G. C. McLeod 25 Apr. 1964 25 p refs

(Contract AF 19(604)8443)

(AFCRL-64-342; AD-610863)

The y-2 mutant strain of the unicellular green alga *Chlamydomonas reinhardi* undergoes bleaching and regreening under rigidly defined, controllable conditions. Development of several photosynthetic reactions during regreening was studied; rates of several reactions remained constant during the first 2 to 3 hours, then increased rapidly. It is suggested that this increase is triggered by development of a structurally active chloroplast or subunit of the chloroplast. This unit could provide for physical separation of products and for their transport to regions of the cell suitable for their protection and metabolism. That the proteins play a predominant role is certain, since the function of the chlorophylls depends partly on photochemical reactions in which properties of the pigment–protein complex are essential. Several forms of this complex appear extant and able to change into one another during development. The regreening cell is a dynamic system whose photosynthetic capabilities are bound to the chloroplast and vary with environment. Author

N65-24488 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DOSE OF COSMIC RADIATION IN BIO-UNITS OF VOSTOK-3 AND VOSTOK-4

V. N. Lebedev, V. S. Morozov, G. F. Murin, M. D. Nikitin, and M. I. Salatskaya *In its* Cosmic Res. 6 Feb. 1964 p 196–199 refs (See N65-24475 14-29)

Special biounits in Vostok-3 and Vostok-4 measured the dose of cosmic radiation by P and K nuclear emulsions, a scintillation photodosimeter, and type XX X-ray film. As a result of the measurements, the total dose of cosmic radiation during flight was 41 ±6 mrad for Vostok-3 and 30 ±4 for Vostok-4. Author

N65-24489 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFECT OF SPACE FLIGHT FACTORS ON THE VOSTOK-3 AND VOSTOK-4 ON THE MICROSPORES OF *TRADESCANTIA PALUDOSA*

N. L. Delone, P. R. Popovich, V. V. Antipov, and V. G. Vysotskiy *In its* Cosmic Res. 6 Feb. 1964 p 200–224 refs (See N65-24475 14-29)

In experiments on microspores of *Tradescantia* a portion of the material was fixed by P. R. Popovich 56 hr after the start, which precluded the effect of vibration and accelerations acting on biological objects during launch of the spaceship. On analysis of the material obtained, a new type of arrangement, spherical fragments, was detected which can be recorded not only in the metaphase, anaphase, and telophase, but also in the prophase, and interphase. Different mitotic disorders were noted. Author

N65-24490 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFECT OF SPACE FLIGHT FACTORS ON THE INCIDENCE OF SEX-LINKED RECESSIVE LETHAL MUTATIONS IN *DROSOPHILA MELANOGASTER*

Ya. L. Glembotskiy, Yu. A. Lakhin, G. P. Parfenov, and Ye. M. Kamshilova *In its* Cosmic Res. 6 Feb. 1964 p 225–240 refs (See N65-24475 14-29)

Tests described were carried out on Vostoks-3 and -4 to elucidate the effect of space flight factors on the incidence of several types of mutations in *Drosophila melanogaster*. These data coincide with results of analogous tests carried out during the preceding five space flights not only with *Drosophila*, but with other objects (mice, seeds of different plants). It was established that the reaction of each of these objects to conditions of different flights varies greatly, but a parallelism of the hereditary reaction of these objects to conditions of one and the same flight was observed. It was hypothesized that this is because of the variability of the mutagenic effect of certain space flight factors from flight to flight. That such factors may be weightlessness, rocket vibration, velocity, or cosmic radiation is discussed. It is improbable that one factor alone can cause the observed effects. Author

N65-24575*# Pennsylvania State Univ., University Park.

PHYSICS OF CELLULAR SYNTHESIS, GROWTH AND DIVISION Annual Status Report, 1 Apr. 1964–31 Mar. 1965

Ernest C. Pollard 30 Apr. 1965 14 p refs

(Grant NsG-324)

(NASA-CR-62925) CFSTI: HC $1.00/MF $0.50

Separate reports on research progress and current work in cellular growth, synthesis, and division physics are given. The reports cover radiation and pressure effects on bacterial cells, incorporated tritium compounds decay in *E. coli*, calculation of regional energy deposits in localized tritium, lethality mechanism by tritium decay in T4 coliphage, polyelectrolytic solutions, ionizing radiation effect on the configuration of DNA, electron spectrum resonance of irradiated single-crystal thymidine, and microspectrophotometry instrumentation error. R.C.S.

N65-24592# Palo Alto Medical Research Foundation, Calif.

THE OXYGEN DELIVERY RATE OF HUMAN BLOOD

J. Percy Baumberger, Helen Chinn Leong, and J. Ryan Neville Brooks AFB, Tex., School of Aerospace Med., Dec. 1964 19 p refs Prepared jointly with Stanford Univ.

(Contracts AF 41(609)-1695; AF 41(657)-255)

(SAM-TR-64-89; AD-461389)

Blood's oxygen delivery rate (ODR) is discussed, and polarographic methods for its study are presented. Experimental results show (1) an increase in ODR with decrease in percent saturation of hemoglobin and (2) a significant difference in the ODR of the blood of one individual as compared to that of another. Significance of ODR to tissue hypoxia and the general relationship of ODR to other aspects of the oxygen transport system are discussed. While no definite explanation has been found for the observed individual differences in ODR, variations in the erythrocytes themselves appear decisive. Author

N65-24593# Aerospace Medical Div. Arctic Aeromedical Lab., Fort Wainwright, Alaska.

COMPOSITION OF GAINS DURING PROTEIN REPLETION IN THE COLD

David A. Vaughan and Lucile N. Vaughan Dec. 1964 14 p refs (AAL-TDR-64-15; AD-462160)

Male Sprague–Dawley rats were fed a nitrogen-free diet at 25° and 7° C. At the end of a 10-day depletion period, they were fed diets containing 6%, 9%, 12%, 15% and 18% casein for 14 days. Carcass analyses (minus liver and intestinal contents) were carried out for protein, water and fat. At 6% casein, carcass accretion consisted mainly of fat in both groups, with very little nitrogen increment. At higher levels of casein, tissue protein accretion reflected dietary protein increments at both temperatures, although fat accretion was somewhat reduced at 7° C. In a second experiment, fibrin at 6% and 9% was compared with casein during repletion at both temperatures. Fat accretion at both levels of fibrin was significantly reduced at 7° C, although other tissue increments were not appreciably affected. These results indicate that weight gains at low levels of protein consist mainly of nonprotein components and that cold exposure tends to normalize tissue accretion at these levels. Increased intake of protein resulting from the increased consumption of food in the cold is a possible explanation. Author

N65-24616 Akademie der Wissenschaften und der Literatur, Mainz (West Germany).

SPECTROGRAPHIC RESEARCH ON THE EFFECT OF IONIZING RAYS ON ELEMENTARY BIOLOGICAL OBJECTS, USING PARAMAGNETIC ELECTRON RESONANCE [SPEKTROGRAPHISCHE UNTERSUCHUNGEN MITTELS PARAMAGNETISCHER ELEKTRONENRESONANZ UBER DIE WIRKUNG IONISIERENDER STRAHLEN AUF ELEMENTARE]

Adolf Müller 1964 123 p refs In GERMAN *Its* Abhandl. der Math.–Naturwiss. Klasse No. 5 Available from the Akad. der Wiss. und der Lit.: 11.60 DM

By ionization at 100° and 300° K induced radicals in dry bacteriophage and their components were measured by spectral analysis. Comparison of the phage-protein and phage-nucleic acid spectra with the dose effectiveness of the radical concentration showed cleavage of the H-atoms and resulting induction of the carbon radicals. All substances showed a correlation between the radical concentration and the radiation dosage of X-rays, and γ-rays, as well as α-radiation. It was concluded that the observed radicals constitute biological damage regardless of their physical-chemical nature. G.G.

N65-24618# Scientific Committee on the Effects of Atomic Radiation (UN).

REPORT OF THE UNITED NATIONS SCIENTIFIC COMMITTEE ON THE EFFECTS OF ATOMIC RADIATION

1964 123 p refs Official Records of Gen. Assembly, 19th Session, Suppl. No. 14(A/5814)

Discussed is the contamination of the environment by nuclear explosions, the mechanisms of radiation uptake in food chains and eventually in body tissues, and the possibility of quantitatively assessing the risk of induction of malignancies by radiation in man. Strontium 90 and cesium 137

are the most important fission products from nuclear explosion that contaminate man's diet, and in 1963 dietary contamination levels in the Northern Hemisphere were considerably higher than those in the Southern Hemisphere. The transfer of cesium 137 through food chains to man is enhanced under certain ecological conditions, and exceeds the world average by a factor of more than 100 in inhabitants of arctic regions who live mostly on reindeer and caribou meat. Short-lived radionuclides have been measured in the environment, in food, and in the human body more often since the end of 1961. Estimates of the radiation relation to cancer induction in man are presented based on dose commitments to the gonads, to the cell lining bone surfaces, and to the bone marrow. Technical indexes contain the available scientific information. G.G.

N65-24619# Iowa State Univ. of Science and Technology, Ames. Inst. for Atomic Research
ORGAN DISTRIBUTION FOLLOWING AN INTRAPULMONARY INJECTION OF RARE-EARTH COMPOUNDS
Fred C. Davison, William O. Reece, and Richard B. Talbot Apr. 1965 21 p refs
(Contract AT(11-1)-1170)
(COO-1170-3) CFSTI: $1.00

Distribution studies in guinea pigs and rats, following intrapulmonary injections of stable rare-earth citrates and oxalates, showed significant lung burden still present 120 days after injection. Data presented demonstrate translocation to the femur, liver, kidney, spleen, heart, adrenals, gonads and brain. Author

N65-24622# Rochester Univ., N. Y.
PLATELET SIZE DISTRIBUTION FOLLOWING X-IRRADIATION
R. O. Spertzel, T. J. Bucci, and M. Ingram 19 Apr. 1965 17 p Presented at the 2d Intern. Cong. of Radiation Res., Harrogate, England, 5–11 Aug. 1962
(Contract W-7401-ENG-49)
(UR-663) CFSTI: $1.00

Routine microscopic examination of stained blood films has indicated that platelet size becomes irregular in dogs during recovery from single large X-ray doses, and in men receiving low level exposures over long periods. A differential sedimentation method using polyvinylpyrolidone (PVP) is used to obtain suspensions of platelets nearly free of contaminating red and white cells. The final dilution of platelet suspension prepared just prior to size distribution analysis is 1:250 in modified saline. The platelet volumes in male and female dogs are analyzed. Consecutive sampling of the same animal resulted in strikingly consistent histograms, and the histograms of male and female dogs vary greatly, indicating a sex-dependent distribution. All histograms showed an asymmetric tailing in the larger volumes during recovery, which was not seen in normal platelet populations. A bar graph showing a typical sequence of changes in an irradiated dog is presented. R.C.S.

N65-24623# Atomic Energy Commission, Washington, D. C. Div. of Nuclear Education and Training
LABORATORY EXPERIMENTS IN RADIATION BIOLOGY
Edward I. Shaw (Kansas Univ.) Apr. 1965 86 p refs
(Contract AT(11-1)-1093)
(TID-18616 (Rev.)) GPO: $0.50

This laboratory manual provides a set of experiments on radiation biology which demonstrate the operation of fundamental principles without the use of costly equipment. Discussed are special techniques and the preparation of special equipment; characteristics of radiation detection instruments; the interaction of radiations with matter; methods of measurement of radiation, and assay of radioactivity in various materials; radioactive tracer experiments; and experiments on the biological effects of radiation. Several experiments are included which use ultraviolet radiations from germicidal or short wave ultraviolet lamps. G.G.

N65-24674*# Chicago Univ., Ill. Dept. of Biophysics
INTEGRATED RESEARCH AND TRAINING IN SPACE-MOLECULAR BIOLOGY Annual Progress Report, Apr. 1, 1964–Mar. 31, 1965
Humberto Fernandez-Moran [1965] 50 p refs
(Grant NsG-441-63)
(NASA-CR-62879) CFSTI: HC $3.00/MF $0.50

The organization, testing, and operation of the electron microscope laboratories was completed, and all laboratories are fully operational. A 2.8 Å resolution was obtained for the first time by imaging the (200) plane of NaCl crystals by direct illumination using a special pointed filament with tantalum tip. Research continued in correlated electron microscope and electron diffraction studies of Orgueil carbonaceous chondrite meteorites; electron microscopical studies of pre-Cambrian organized systems; and electron microscopy experiments with high-field superconducting solenoid lenses of niobium–zirconium and niobium–tin alloys. Training of several persons was carried out in connection with the various research projects. G.G.

N65-24690# Joint Publications Research Service, Washington, D. C.
EFFECT OF ADRENOCORTICAL INSUFFICIENCY AND HYPERFUNCTION ON THE SENSITIVITY OF RATS AND MICE TO CARBON MONOXIDE POISONING
V. A. Pukhov 27 May 1965 6 p refs Transl. into ENGLISH from Farmakol. i Toksikol. (Moscow), v. 27, no. 3, May–Jun. 1964 p 343–345
(JPRS-30295; TT-65-31105) CFSTI: $1.00

The effect of adrenocortical insufficiency on resistance to carbon monoxide poisoning after excision or autotransplantation of the adrenals in mice and rats is studied. Within a week after the operation, resistance of rats with adrenal transplants was at its lowest and was no different from that of rats with the adrenal removed. Two weeks after the operation, the percentage of survival among rats increased, and after a month the experimental group differed very little from the control group in resistance to CO poisoning. Resistance to oxygen deficiency followed the same pattern. Adrenocorticoid hypofunction, expressed in impaired production of glucocorticoids, has a negative effect on the adaptability of the organism to oxygen deficiency. Preliminary injections of ACTH increases the resistance of rats to CO. On the basis of these results, it is concluded that a high functional level of the adrenal cortex contributes to the adaptation of the body to oxygen deficiency. R.C.S.

N65-24691# Joint Publications Research Service, Washington, D. C.
EFFECT OF ASPHYXIA ON THE ECG OF PUPPIES AND KITTENS OF DIFFERENT AGES
M. M. Kohanovs'ka 28 May 1965 8 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 10, no. 5, Sep.–Oct. 1964 p 609–614
(JPRS-30297; TT-65-31106) CFSTI: $1.00

Changes in the ECG during asphyxia in puppies and kittens of different ages, as well as in mature animals used for controls, were studied. A total of 45 dogs and 25 cats, including 36 newborns, 15 two weeks old, 13 one and a half-months old, and 6 mature, were examined. Asphyxia was induced through compression of the trachea. Results show that during asphyxia changes in cardiac rhythm are clearly age-related. In mature animals the marked slowing down of the rhythm observed during the 1st and 2nd minutes of asphyxia shifts to marked

acceleration of the heart beat. In newborn puppies and kittens the slower cardiac rhythm which develops after the initial sharp reduction is of a gradual type. Acceleration of rhythm, which can be observed as asphyxia develops, starts later (5th or 6th minute) and is less pronounced. Detection of age-related features of irradiation of excitation from the respiratory center is also described. N.E.A.

N65-24727# California Univ., Livermore. Lawrence Radiation Lab.

SPECIAL PROBLEMS OF THYROID DOSIMETRY: CONSIDERATIONS OF I^{131} DOSE AS A FUNCTION OF GROSS SIZE AND INHOMOGENEOUS DISTRIBUTION

Lynn R. Anspaugh 25 Mar. 1965 21 p refs
(Contract W-7405-ENG-48)
(UCRL-12492) CFSTI: $1.00

Problems concerned with an accurate calculation of I^{131} dose to the thyroid are considered. Detailed calculations presented show that an error of only 3% to 6% is involved if dose equations which treat the thyroid as an infinite medium are used. This is true even for an infant's thyroid weighing only 1.71 g. Effects of apparent nonuniform distribution of I^{131} are also considered. A model system wherein all the I^{131} is confined to colloid spheres occupying 50% of the thyroid volume is found to deliver a uniform dose throughout the thyroid. That hot spots involving several follicles might occur is considered in light of reported literature studies of human and animal thyroids. The conclusion drawn from these considerations is that such hot spots will not occur in normal, but might in diseased thyroid tissue. Author

N65-24732# Joint Publications Research Service, Washington, D. C.

ARTICLES FROM MEDITSINSKAYA GAZETA (MEDICAL GAZETTE)

6 May 1965 12 p Transl. into ENGLISH from Med. Gazeta (USSR), 26 Jan. 1965 p 3
(JPRS-29953; TT-65-30928) CFSTI: $1.00

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1. TULAREMIA N. Osuf'yev p 1–3
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3. LONG-RANGE RESULTS OF SURGERY FOR CORONARY INSUFFICIENCY B. Korolev p 7–9

N65-24733 Joint Publications Research Service, Washington, D. C.

PHYSIOLOGY OF FLYING

F. Kosmolinskiy *In its* Articles from Med. Gazeta 6 May 1965 p 4–6 (See N65-24732 14-04) CFSTI: $1.00

Aviation physiology is concerned with the interaction of the organism and the environment during flight. It establishes the laws governing the activity of the organism in performing various tasks, and works out the methods for developing in pilots useful occupational skills and physical endurance. Problems of aviation investigations, difficulties in calculating a variety of factors and conditions that affect the pilot, and the relationship between aviation physiology and other allied disciplines are discussed. N.E.A.

N65-24736# Joint Publications Research Service, Washington, D. C.

ARTICLES FROM KRASNAYA ZVEZDA (RED STAR), 7 MARCH 1965

14 May 1965 6 p Transl. into ENGLISH from Krasnaya Zvezda (Moscow), 7 Mar. 1965
(JPRS-30083; TT-65-30993) CFSTI: $1.00

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1. AUTOSUGGESTION EXPERIMENTS IN KARAGANDA p 1
2. CAN MAN LIVE BEYOND THE LIMITS OF THE PLANET? p 2–4 (See N65-24737 14-04)

N65-24737 Joint Publications Research Service, Washington, D. C.

CAN MAN LIVE BEYOND THE LIMITS OF THE PLANET?

In its Articles from Krasnaya Zvezda (Red Star), 7 Mar. 1965 14 May 1965 p 2–4 (See N65-24736 14-04) CFSTI: $1.00

This article is primarily a rebuttal to an editorial on the adverse affects of weightlessness on humans. It is observed that the action of gravitational force stimulates quite a few receptor organs–including such types of sensory apparatus as the labyrinths. Under conditions of weightlessness the sensory input arising from the effects of gravitational force ceases. Although it was thought that irreversible conditions might result, such that coordinated movements would be disturbed, this does not occur. Individual disturbances in function appeared in some subjects in the form of dizziness. However, other cosmonauts who remained in orbit for rather long times experienced no unpleasant sensations. E.E.B.

N65-24810# Naval School of Aviation Medicine, Pensacola, Fla. Naval Medical Center

EVALUATION AND PREDICTION OF PHYSICAL FITNESS, UTILIZING MODIFIED APPARATUS OF THE HARVARD STEP TEST

John L. Patterson, Jr., Ashton Graybiel, Harry F. Lenhardt, and M. Jones Madsen 15 Dec. 1964 34 p refs *Its* Rept.-4
(NSAM-890; AD-458383)

Investigations on methods for the evaluation of physical fitness suitable for both military and civilian personnel are summarized. The results with maximal tests of fitness utilizing two grades of severe muscular work are presented, together with correlations among performance, degree of training, and age of the subjects. In addition, measurements made on submaximal tests are compared with the maximal performances, and the possibilities of predicting maximal performance are discussed. Data on the reliability of heart rate curves during exercise and recovery from exercise are presented, together with observations on their sensitivity to the effects of mild illness. Author

N65-24875# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS FROM FIZIOLOGICHNYY ZHURNAL (PHYSIOLOGICAL JOURNAL), VOL. XI, NO. 1, 1965

17 May 1965 35 p refs Transl. into ENGLISH from Fiziol. Zh. (Kiev), v. 11, no. 1, Jan.–Feb. 1965
(JPRS-30099; TT-65-31001) CFSTI: $2.00

CONTENTS:

1. THE DEVELOPMENT IN THE UKRAINE OF THE IDEAS OF A. A. BOGOMOLETS ON HUMAN PHYSIOLOGICAL AGING AND LONGEVITY A. F. Makarchenko and A. Z. Kolchinskaya p 1–11
2. HUMAN THERMOREGULATION IN THE LIGHT OF CYBERNETICS M. K. Vitte p 12–18 refs (See N65-24876 14-04)
3. REACTION OF THE NEURAL ELEMENTS OF THE GASTROINTESTINAL TRACT TO THE RADIATION EFFECT DUE TO TOTAL X-RAY IRRADIATION Z. Ya. Tkachenko p 19–28 refs (See N65-24877 14-04)
4. SCIENTIFIC CONFERENCE ON THE DETERMINATION OF OXYGEN PRESSURE IN LIVING TISSUE BY THE POLAROGRAPHIC METHOD V. A. Berezovskiy p 29–32 (See N65-24878 14-04)

N65-24876 Joint Publications Research Service, Washington, D. C.

HUMAN THERMOREGULATION IN THE LIGHT OF CYBERNETICS

M. K. Vitte *In its* Transl. from Fiziol. Zh. (Physiol. J.), Vol. XI, No. 1, 1965 17 May 1965 p 12–18 refs (See N65-24875 14-04) CFSTI: $2.00

The present state of development of the theory of heat exchange in man permits representing the diversified influence of weather conditions (temperature, humidity, movement of the air, and thermal radiation), as well as the level of heat formation of the body, in the form of mathematical equations. In view of this the author expresses the hypothesis that information on environmental factors which affect thermoregulation can be programed, and that the process of thermoregulation can be studied with utilization of the laws of cybernetics. Author

N65-24877 Joint Publications Research Service, Washington, D. C.

REACTION OF THE NEURAL ELEMENTS OF THE GASTROINTESTINAL TRACT TO THE RADIATION EFFECT DUE TO TOTAL X-RAY IRRADIATION

Z. Ya. Tkachenko *In its* Transl. from Fiziol. Zh. (Physiol. J.), Vol. XI, No. 1, 1965 17 May 1965 p 19–28 refs (See N65-24875 14-04) CFSTI: $2.00

The effects of radiation on the reflexogenic zones of the digestive tube were studied experimentally in rabbits. Eighteen rabbits were subjected to whole-body X-ray irradiation dose of 1100 R, after which the animals were sacrificed at 1 hour, 1, 3, 5, or 7 days. The greatest changes were found in the neural plexuses of the esophagus and stomach, especially in the motor cells of the Auerbach's and Meissner's plexuses, which manifested dystrophy and destruction; purely compensatory reactions occurred in the other gastrointestinal areas. In the radiated muscle fibers, destruction was most often observed in the fibers of the cable bundles of muscle layers. Along with the severe damage, however, reorganization of the nucleus of the nerve cells, growth of dendritic processes, and proliferation of glia, appeared even after on the 7th day after irradiation. J.M.D.

N65-24878 Joint Publications Research Service, Washington, D. C.

SCIENTIFIC CONFERENCE ON THE DETERMINATION OF OXYGEN PRESSURE IN LIVING TISSUE BY THE POLAROGRAPHIC METHOD

V. A. Berezovskiy *In its* Transl. from Fiziol. Zh. (Physiol. J.), Vol. XI, No. 1, 1965 17 May 1965 p 29–32 (See N65-24875 14-04) CFSTI: $2.00

Various polarographic studies of oxygen pressure in tissue and of new polarographic methodologies are indicated. Topics recently under investigation include variation in oxygen pressure throughout the body when in different physiological states, oxygen pressure in the cerebrum of rats under the influence of narcotics, dependence of tissue oxygen pressure on the permeability of the cellular wall, changes in oxygen pressure in the myocardium, and correlation of the oxygen pressure in the brain and its bioelectric activity. Most of the polarographic instruments used in these studies were simple electrodes inadequate for definitive studies; more complex electrodes, similar to the Clark electrodes used for measurement of blood pressure, will be necessary. In studies of new methods, an open platinum electrode was used for clinical investigation of oxygen pressure in porous tissue in man, and a model was designed with mercury electrodes which might be adequate for rapid determination of the dissociation curve of blood hemoglobin. J.M.D.

N65-24887# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 182

28 May 1965 62 p refs

(JPRS-30299; TT-65-31107) CFSTI: $3.00

CONTENTS:

1. ORAL CONTRACEPTIVE STEROIDS Wei-shan Chou and Ming-lung Huang p 1–25 refs

2. EFFECT OF SECONDARY ELECTRONS IN RADIOCHEMICAL SYSTEMS Man-wei Chang p 26–49 refs (See N65-24888 14-06)

3. ENTOMOLOGICAL MEETING DISCUSSES DESTRUCTION OF PESTS p 50–51

4. CONFERENCE HELD TO DISCUSS PREVENTION OF SCHISTOSOMIASIS IN KIANGSU AND CHEKIANG p 52–54

5. NEW DRUG FOUND FOR TREATING SCHISTOSOMIASIS p 55–59

N65-24889# Joint Publications Research Service, Washington, D. C.

BURN SHOCK AND CYBERNETICS, ARTIFICIAL BLOOD CIRCULATION, AND A 20-CATHODE MULTIPOLAROGRAPH

3 Jun. 1965 25 p refs Transl. into ENGLISH from Patol. Fiziol. i Eksperim. Terapiya (Moscow), v. 9, no. 1, Feb. 1965 p 3–10, 60–62, 74–76

(JPRS-30405; TT-65-31159) CFSTI: $1.00

CONTENTS:

1. BURN SHOCK AS AN AUTOMATIC CONTROL PROCESS Ye. V. Gubler p 1–12 refs (See N65-24890 14-04)

2. CHANGES IN BODY AND BLOOD TEMPERATURE IN PATIENTS OPERATED UNDER CONDITIONS OF ARTIFICIAL BLOOD CIRCULATION WITH A MODERATE HYPOTHERMIA I. Yu. Vinokurova p 13–17 refs (See N65-24891 14-04)

3. 20-CATHODE MULTIPOLAROGRAPH R. B. Stelkov p 19–22 refs (See N65-24892 14-04)

N65-24890 Joint Publications Research Service, Washington, D. C.

BURN SHOCK AS AN AUTOMATIC CONTROL PROCESS

Ye. V. Gubler *In its* Burn Shock and Cybernetics, Artificial Blood Circulation, and a 20-Cathode Multipolarog. 3 Jun. 1965 p 1–12 refs (See N65-24889 14-04) CFSTI: $1.00

An attempt is made to analyze burn shock by considerations of automatic control in the organism during pathological processes. An interrelation scheme is shown that presents the main physiological parameters for burn shock, the effects resulting in deviation from the standard, and the control circuits restricting their deviation. The control processes in burn shock are discussed, and the reasons for the pathological deviations are given. Attempts at mathematical modeling of the total burn shock process are still unsuccessful since some of the pathological deviations are a direct consequence of disruptive effects. However, most represent the reverse side of the control reactions, where often deviations of several parameters from standard limits appear in order to limit the dangerous deviation of one parameter. In addition, deviations controlling one circuit might be disruptive for another one. G.G.

N65-24891 Joint Publications Research Service, Washington, D. C.

CHANGES IN BODY AND BLOOD TEMPERATURE IN PATIENTS OPERATED UNDER CONDITIONS OF ARTIFICIAL BLOOD CIRCULATION WITH A MODERATE HYPOTHERMIA

I. Yu. Vinokurova *In its* Burn Shock and Cybernetics, Artificial Blood Circulation, and a 20-Cathode Multipolarog. 3 Jun. 1965 p 13–17 refs (See N65-24889 14-04) CFSTI: $1.00

The relationships between temperatures in various parts of the body during artificial blood circulation combined with modern hypothermia were studied on patients with open heart surgery. Temperatures were recorded in a 1-minute interval in the esophagus, rectum, tympanum, muscles, and the venous outflow from the patient. The following perfusion stages were observed: (1) active cooling during blood circulation in the heat exchange system; (2) passive cooling at the expense of previously cooled blood without subsequent temperature reduction of the blood; and (3) active warming during pumping of blood warmed in the heat exchange. It was concluded that body temperature changes in patients during perfusion are closely related to the temperature of the donor's blood pumped by the equipment during the first minutes of artificial blood circulation as well as to the temperature of mixed blood pumped during the entire perfusion period. Perfusion at 35° to 36° C in the first minutes of artificial blood circulation with a subsequent gradual temperature reduction to the required level is advised for patients with low initial temperatures. G.G.

N65-24892 Joint Publications Research Service, Washington, D. C.

20-CATHODE MULTIPOLAROGRAPH

R. B. Stelkov *In its* Burn Shock and Cybernetics, Artificial Blood Circulation, and a 20-Cathode Multipolarog. 3 Jun. 1965 p 18–22 refs (See N65-24889 14-04) CFSTI: $1.00

Described is a multipolarograph that uses one reflecting galvanometer for the simultaneous determination of the maximal current in 20 objects. Point-contact electrodes and a special switchboard are used to obtain integrated data for the induced current which is determined by the quantity of the reducible substance in all 20 cathodes. The current strength is directly proportional to the cathode area under equal conditions of changes in all objects being examined. This formation of a large number of electrodes increases the observed area and makes it possible to decrease by 10 to 20 times the area of each separate electrode and to obtain averaged data on the quantity of the substances observed in very limited segments of identical tissues or samples. Data are presented on oxygen voltage in the brain tissues of 20 mice after administration of 2.5 mg adrenalin per kg of body weight; an increase of 20.3 ±3.9% resulted. G.G.

N65-24899*# Dynamic Science Corp., South Pasadena, Calif.

MICROORGANISMS IN SOLID MATERIALS. PHASES I, II, III, AND IV Final Summary Report

Earl G. Mc Nall and William T. Duffy 23 Apr. 1965 150 p refs Prepared for JPL

(Contract NAS7-100; JPL-950740)

(NASA-CR-62980) CFSTI: HC $4.00/MF $1.00

For a high degree of reliability of microbial decontamination, methods for the detection of viable microorganisms, as sensitive and reliable as possible must be developed. Detection of microorganisms within the interstices of solid materials may be approached conceptually from a number of directions. Of detection methods studied—culturing, electron spin resonance nonfluorescent staining, fluorescent staining, electrophoresis, and autoradiography—culturing is most reliable. This method depends on the ability of the microorganism to undergo cellular division. There are deficiencies in this method since physical and/or chemical trauma associated with the exposure of the microorganism from its location within the solid may cause inability to demonstrate the organisms' viability by culture methods. Author

N65-24915 National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board

BIOLOGICAL STUDIES

In its U.S. Space Sci. Program. Rept. to COSPAR 1963 p 85–98 ref (See N65-24908 14-30)

Researches in the following fields are reported: (1) Exobiology includes not only the search for extraterrestrial life or fossil evidence for it, but a study of the organic chemistry of stages that are hypothetical forerunners of living forms, and of sterilization techniques necessary to prevent the contamination of extraterrestrial environments and the destruction of possible exobiota. (2) Environmental biology studies effects on biological processes of those properties of space (weightlessness, absence of diurnal rhythms, etc.) uniquely different from the normal earth-bound environment. (3) Human physical and psychological factors requiring attention are studied; they include life support, radiation protection, and reaction to abnormal stimuli or its lack (isolation, etc.). Author

N65-24938# Joint Publications Research Service, Washington, D. C.

HYGIENE AND SANITATION IN THE USSR

26 May 1965 72 p refs Transl. into ENGLISH from Gigiena i Sanit. (Moscow), no. 3, Mar. 1965 p 8–13, 17–21, 42–55, 61–66, 114–116

(JPRS-30241; TT-65-31077) CFSTI: $3.00

CONTENTS:

1. MATERIALS FOR DETERMINING THE MAXIMUM PERMISSIBLE CONCENTRATION OF CHLOROBENZOL IN ATMOSPHERIC AIR L. P. Tarkhova p 1–9 refs (See N65-24939 14-04)

2. CHANGES IN SOME BIOCHEMICAL INDICES OF THE OXIDIZING PROCESSES IN ADAPTATION TO COLD L. A. Guseva p 10–17 refs (See N65-24940 14-04)

3. MATERIAL FOR DETERMINING THE AIR EXCHANGE IN ROOMS FOR POWERFUL GAMMA-INSTALLATIONS N. V. Sobol', A. Kh. Breger, and A. A. Petrushkov p 18–28 refs (See N65-24941 14-04)

4. THE PROTECTIVE ROLE OF FOOD AND VITAMINS IN RADIATION INJURIES TO THE ORGANISM S. R. Perepelkin p 29–43 refs (See N65-24942 14-04)

5. DETERMINATION OF FURFUROL IN THE AIR A. A. Belyakov and V. G. Smirnova p 44–47 refs (See N65-24943 14-06)

6. A FAST METHOD FOR DETERMINING LEAD IN THE AIR V. A. Razumov and T. K. Aydarov p 48–50 refs (See N65-24944 14-06)

7. A CHROMATOGRAPHIC METHOD FOR DETERMINING URANIUM AND PLUTONIUM IN THE AIR V. F. Pomytkin, A. M. Vorob'yev, G. B. Bokova, and V. I. Fomicheva p 51–54 refs (See N65-24945 14-06)

8. SOME PROBLEMS OF PREVENTIVE SANITARY SUPERVISION OVER ATMOSPHERIC AIR PROTECTION IN THE DNEPROPETROVSK OBLAST V. I. Petrov and G. K. Kameko p 55–58

9. THE WATER FACTOR IN THE EPIDEMIOLOGY OF TYPHOID FEVER A. M. Levitov and A. I. Tolkachev p 59–62

10. BLOOD-SERUM PROTEINS IN CONTACT WITH LEAD P. M. Yaverbaum p 63–65

11. CONFERENCE ON TOXICOLOGY AND HYGIENE OF HIGH-MOLECULAR COMPOUNDS S. L. Danishevskiy p 66–69

N65-24939 Joint Publications Research Service, Washington, D. C.
MATERIALS FOR DETERMINING THE MAXIMUM PERMISSIBLE CONCENTRATION OF CHLOROBENZOL IN ATMOSPHERIC AIR
L. P. Tarkhova *In its* Hyg. and Sanit. in the USSR 26 May 1965 p 1–9 refs (See N65-24938 14-04) CFSTI: $3.00

The content of chlorobenzol in atmospheric air and the action of small concentrations of it on man is investigated. It is shown that the threshold perception of chlorobenzol is 0.4 mg/cu m for the most sensitive person. The threshold of its action on the electric activity of the brain is 0.2 mg/cu m. The maximum single-time permissible concentration lies at the 0.1 mg/cu m level. Chlorobenzol in 1 mg/cu m concentration in the chronic treatment of white rats causes a lowering and distortion of the correct ratio of the chronaxia of the antagonist muscles, raises the cholinesterase activity, and lowers the alpha globulin content of the blood serum. Chlorobenzol in 0.1 mg/cu m concentration in chronic treatment on white rats does not cause the changes observed at high concentration of that substance (1 mg/cu m). The average 24-hr maximum permissible chlorobenzol concentration may be at the level of the maximum single-time concentration (0.1 mg/cu m). N.E.A.

N65-24940 Joint Publications Research Service, Washington, D. C.
CHANGES IN SOME BIOCHEMICAL INDICES OF THE OXIDIZING PROCESSES IN ADAPTATION TO COLD
L. A. Guseva *In its* Hyg. and Sanit. in the USSR 26 May 1965 p 10–17 refs (See N65-24938 14-04) CFSTI: $3.00

Evaluations of the oxidizing processes after chilling of subjects adapted to cold and not adapted to cold are made. Changes in the oxidizing processes after chilling of cold adapted and noncold adapted subjects were evaluated from the accumulation of lactic acid and pyrotartaric acids in the blood, and from secretions of incompletely oxidized products of metabolism in the urine. Chilling of persons adapted to cold caused no increase in the blood pyrotartaric acid content, however the initial quantity of pyrotartaric acid was 20% higher than in persons not adapted to cold. The organic acid content in the urine of unadapted persons dropped sharply during chilling, while in those adapted to cold almost no change was observed. It is concluded that the chilling of organisms adapted to cold causes no sharp changes in the metabolism in the period of exposure, but the initial levels of metabolism, according to the indices studied, are clearly higher than in unadapted organisms. It is assumed that one of the characteristics of an organism adapted to cold is the establishment of metabolism on a new and higher level. N.E.A.

N65-24941 Joint Publications Research Service, Washington, D. C.
MATERIAL FOR DETERMINING THE AIR EXCHANGE IN ROOMS FOR POWERFUL GAMMA-INSTALLATIONS
N. V. Sobol', A. Kh. Breger, and A. A. Petrushkov *In its* Hyg. and Sanit. in the USSR 26 May 1965 p 18–28 refs (See N65-24938 14-04) CFSTI: $3.00

On the basis of the theoretical computations and experimental data, formulas, and nomograms were given for determining the consumption of air and the frequency of air exchange in irradiation chambers depending on the volume of the chamber room and the activity of the irradiator. The equations obtained were confirmed experimentally. Author

N65-24942 Joint Publications Research Service, Washington, D. C.
THE PROTECTIVE ROLE OF FOOD AND VITAMINS IN RADIATION INJURIES TO THE ORGANISM
S. R. Perepelkin *In its* Hyg. and Sanit. in the USSR 26 May 1965 p 29–43 refs (See N65-24938 14-04) CFSTI: $3.00

The protective or curative-and-preventive role of food, in cases of acute and subacute radiation injuries, in raising the resistance of the organism is studied. A diet with varying ratios between vegetable and animal proteins and varying compositions of these proteins in interactions with specific vitamin complexes, was used. Results showed that a milk and egg diet had the most favorable effect on test animals in cases of radiation injury, while a liver diet had a less positive effect on the course of the pathological process, followed by the physiological, meat and vivarium diets. When the food was enriched with a complex of vitamins C, P, and group B vitamins in various doses, the severity of the course of radiation sickness declined. By using various diets together with vitamins, one can weaken or intensify the severity of the process provoked by ionizing radiation. N.E.A.

N65-24964# Melpar, Inc., Falls Church, Va.
BIOCHEMICAL FUEL CELL Tenth Quarterly Progress Report, 1 Oct.–31 Dec. 1964
Gordon C. Blanchard and Charles R. Goucher [1964] 54 p refs
(Contract DA-36-039-SC-90878)
(Rept.-10; AD-462449)

An experimental investigation of some factors which regulate hydrogen production from sugars and natural products by micro-organisms is described. Previous studies demonstrated that several natural products including sweet potatoes, Idaho potatoes, peas, beans, rice, pineapples, and oranges could serve as sources of fuel for hydrogen generation by *Clostridium welchii*. Most of the work is concerned with hydrogen evolution from one of the better natural products, the sweet potato, as well as from sugars. The research showed that nongrowing *Cl. welchii* show no lag before hydrogen evolution. Another milestone was the finding that *Escherichia coli*, a common harmless organism, can be used to produce hydrogen and prepare the medium for the growth of *Cl. welchii*. Also, it was found that hydrogen production can be continued in fermentors for long periods of time by simply periodically adding additional substrate and alkali to the reaction mixture while hydrogen is still being evolved. Author

N65-24993*# Chicago Univ., Ill. Dept. of Biophysics
EXOBIOLOGY STUDY: ANALYTICAL SYSTEMS FOR BIOLOGICAL STUDY OF MARS, THE ROLE OF ELECTRON MICROSCOPY AND ELECTRON OPTICAL TECHNIQUES IN EXOBIOLOGY
Humberto Fernandez-Moran Apr. 1965 25 p refs
(Grant NsG-441)
(NASA-CR-62954) CFSTI: HC $1.00/MF $0.50

The possible contributions of electron microscopy and related electron optical techniques, centering on experiments in situ, with telemetry back to earth, are discussed. Essentially, the approach is based on the fundamental role of microscopy in science and represents a logical complement and extension of the automatic light microscope for use on a planet. The distinctive methodological features of electron microscopy are outlined, and the essential engineering details are presented for a specific project embodying a miniaturized electron microscope with coupled preparative devices for sampling, preparing, sorting, and telemetering of specimen data. Also, some promising approaches in the development and implementation of proposals are surveyed with particular emphasis on the priority to be assigned. E.E.B.

N65-25023# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension

ISOTOPE TECHNIQUES IN THE BIOLOGICAL SCIENCES A Literature Search

Helen L. Ward, comp. May 1965 54 p refs (TID-3512 (Suppl. 1)) CFSTI: $2.00

A total of 463 selected references on new techniques and instruments for using radioisotopes are included in this bibliography. The major reference sources were *Nuclear Science Abstracts, The Bibliography of Agriculture, Biological Abstracts, Chemical Abstracts* and *Index Medicus*. The period covered was 1958 through 1963. Author

N65-25025# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS FROM PATOLOGICHESKAYA FIZIOLOGIYA I EKSPERIMENTAL'NAYA TERAPIYA (PATHOLOGICAL PHYSIOLOGY AND EXPERIMENTAL THERAPY) VOL. IX, NO. 1, 1965

11 May 1965 25 p refs (JPRS-30015; TT-65-30963) CFSTI: $1.00

CONTENTS:

1. CERTAIN FEATURES PECULIAR TO THE CEREBRAL BLOOD SUPPLY UPON REPLACEMENT OF BLOOD LOSS WITH POLYGLUCINE AND BLOOD V. B. Koziner p 1–9 refs

2. EXPERIMENTAL TRANSPLANTATION OF WHOLE SPLEEN TO OVERCOME TISSUE INCOMPATIBILITY A. N. Filatov and G. Ya. Yakovlev p 10–19 refs

3. STAGING OF AN EXPERIMENT DURING PRACTICAL WORK IN PATHOLOGICAL PHYSIOLOGY ON THE SUBJECT OF "OXYGEN STARVATION" E. N. Berger and Ye. A. Markova p 20–22 (See N65-25026 14-04)

N65-25026 Joint Publications Research Service, Washington, D. C.

STAGING OF AN EXPERIMENT DURING PRACTICAL WORK IN PATHOLOGICAL PHYSIOLOGY ON THE SUBJECT OF "OXYGEN STARVATION"

E. N. Berger and Ye. A. Markova *In its* Transl. from Patologicheskaya Fiziol. i Eksperim. Terapiya, V. IX, No. 1, 1965 11 May 1965 p 20–22 (See N65-25025 14-04) CFSTI: $1.00

Reported is the development of a practical method for use in pathophysiological studies of the effects of reduced barometric pressure in small experimental animals, with simultaneous recording of respiration, cardiac activity, and brain wave frequency. Included is a discussion of equipment and results of investigations with rats. S.C.W.

N65-25027# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS FROM BIOFIZIKA (BIOPHYSICS), VOL. X, NO. 1, 1965

17 May 1965 26 p refs Transl. into ENGLISH from Biofizika (Moscow), v. 10, no. 1, 1965 (JPRS-30097; TT-65-30999) CFSTI: $1.00

CONTENTS:

1. THEORY OF GLOBULE-BALL TRANSITIONS IN MACROMOLECULES O. B. Ptitsyn and Yu. Ye. Eyzner p 1–6 refs (See N65-25028 14-04)

2. USE OF THE LUMINESCENCE OF ACRIDINE ORANGE DYE IN THE STUDY OF THE SECONDARY STRUCTURE OF NUCLEIC ACIDS O. F. Borisova and L. A. Tumerman p 7–15 refs (See N65-25029 14-04)

3. THE PROBLEM OF ENERGY CORRELATIONS BETWEEN BIOLUMINESCENCE AND THE RESPIRATION OF LUMINESCENT BACTERIA I. I. Gitel'zon, R. I. Chumakova, and A. M. Fish p 16–23 refs (See N65-25030 14-04)

N65-25028 Joint Publications Research Service, Washington, D. C.

THEORY OF GLOBULE-BALL TRANSITIONS IN MACROMOLECULES

O. B. Ptitsyn and Yu. Ye. Eyzner *In its* Transl. from Biofizika (Biophys.), Vol. X, No. 1, 1965 17 May 1965 p 1–6 refs (See N65-25027 14-04) CFSTI: $1.00

Proposed is a theory to show that the presence of cooperative globule ball transitions in macromolecules during denaturation and of the reverse phenomenon of globularization of polymer chains should, under certain conditions, follow the common premises of macromolecular physics. In contrast to the ball spiral transitions, the globularization of macromolecules represents a true first order phasic transition of the type of gas condensation. The applicability of the theory to any macromolecules where the forces of intramolecular cohesion are greater than the cohesion forces in the molecules of the solvent, as for example in certain block copolymers, and its applicability to globular structures formed in highly diluted solutions of regular polymers, are discussed. The significance of the critical point for globule ball transition is also considered. S.C.W.

N65-25029 Joint Publications Research Service, Washington, D. C.

USE OF THE LUMINESCENCE OF ACRIDINE ORANGE DYE IN THE STUDY OF THE SECONDARY STRUCTURE OF NUCLEIC ACIDS

O. F. Borisova and L. A. Tumerman *In its* Transl. from Biofizika (Biophys.), Vol. X, No. 1, 1965 17 May 1965 p 7–15 refs (See N65-25027 14-04) CFSTI: $1.00

Proposed is a new method for determining the degree of spiralization of a given nucleic acid, which is based on the differences in luminescent characteristics (duration of fluorescence) of acridine orange dye bound with the spiralized (two-band) or despiralized (one-band) segments of the nucleic acid. Results of experiments on spiralization in DNA are presented. Comparative data are included on the basic luminescent and absorption characteristics of acridine orange monomeric molecules in aqueous solutions, the green and red fluorescence band of the same dye bound with DNA, and the dimers of the dye. S.C.W.

N65-25030 Joint Publications Research Service, Washington, D. C.

THE PROBLEM OF ENERGY CORRELATIONS BETWEEN BIOLUMINESCENCE AND THE RESPIRATION OF LUMINESCENT BACTERIA

I. I. Gitel'zon, R. I. Chumakova, and A. M. Fish *In its* Transl. from Biofizika (Biophys.), Vol. X, No. 1, 1965 17 May 1965 p 16–23 refs (See N65-25027 14-04) CFSTI: $1.00

The quantitative correlation between luminescence and glucose consumption by luminescent bacteria was studied to determine what part of the energy obtained by bacteria upon splitting glucose is emitted in the form of visible light. The following were among the results observed from experiments with Photobacterim species: (1) Increased luminescence intensity after the addition of glucose had a definitely marked maximum, after which attenuation set in. (2) The time required to achieve maximum intensity, following glucose addition, and the ratio of maximum luminescence intensity to the luminescence intensity, prior to glucose addition, did not depend on bacterial

concentration. (3) Luminescence intensity and the energy used in the excitation of the luminescent molecule are directly related to the use of the energy substrate. (4) The highest consumption of glucose occurred during the period from the addition of glucose up to the moment of maximal luminescence increase. Determinations of radiant flux, radiant energy, and bacterial density are included. A hypothetical discussion based on the premise that bacterial luminescence represents a direct leakage of energy from the oxidation channel is also included. S.C.W.

N65-25154# United Kingdom Atomic Energy Authority, Risley (England). Safeguards Div.
AN ASSESSMENT OF ENVIRONMENTAL HAZARD FROM FISSION PRODUCT RELEASES
J. R. Beattie 1963 91 p refs
(AHSB(S) R-64) HMSO: 7s 6d

Hazards to the health of the general public that may arise from a release of fission products following a reactor accident are assessed. The proportions of fission products in the reactor are those resulting from a continuous period of operation at power and a preferential release of the more volatile fission products. The dispersion of a release in the atmosphere is discussed, and curves of concentration vs. distance are based on Pasquill's work for average weather and inversion weather conditions. Allowance was made for the depletion of activity by deposition from the cloud as it traveled downwind and special attention was given to the hazards from inhaled or ingested iodine. The magnitudes of various releases were specified in terms of the activity of the iodine-131 component of the release, due to the overriding importance of this isotope with relation to public health hazards following a reactor accident. However, the hazards from other fission product elements and isotopes were also assessed. R.W.H.

N65-25163# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
ANALYTICAL METHODS FOR THE DETERMINATION OF RADIOSTRONTIUM IN BIOLOGICAL MATERIALS
A. Parker, E. H. Henderson, and G. S. Spicer Jan. 1965 40 p refs
(AERE-AM-101) HMSO: 5s 6d

Details are given for the isolation, radiochemical purification, counting, and calculation of the strontium 90 and strontium 89 content of biological materials. These include animal bones, human bones and teeth, milk, and vegetable ashes, and soils. Methods for the calculation of standard deviations of counting are also given. Author

N65-25164# United Kingdom Atomic Energy Authority, Harwell (England). Health Physics and Medical Div.
HEALTH PHYSICS ASPECTS OF PLUTONIUM HANDLING
B. A. J. Lister 1964 208 p refs
(AERE-L-151) HMSO: 40 s

A series of lectures on health physics aspects of plutonium are presented covering these topics: plutonium properties, hazards, and general methods of control; plutonium containment; plutonium monitoring—air sampling; plutonium monitoring—surface and personnel monitoring; plutonium metabolism; plutonium excretion and bioassay; in vivo measurement and treatment of internally deposited plutonium; criticality control in plutonium areas; and emergency procedures and experience in plutonium areas. Author

N65-25203# Florida Univ., Gainesville. Dept. of Physiology
EFFECT OF DIMERCAPTOPROPANOL (BRITISH ANTILEWISITE) ON THE TOXICITY OF OXYGEN AT SIX ATMOSPHERES PRESSURE ON WHITE MALE RATS
Peter V. Van Tassel Brooks AFB, Tex., School of Aerospace Med., Mar. 1965 10 p refs
(Contract AF 41(609)-1553)
(SAM-TR-65-11; AD-461388)

Six groups of 10 white male Holtzman rats were given doses of 10, 25, 40, 50, 75 and 100 mg/kg, respectively, of British antilewisite. Time of onset of the first convulsion after the animals were exposed to 6 atmospheres of oxygen and the survival times were compared with those of 50 control animals. As the dose was increased to 40 mg/kg, both the onset of convulsions and the survival time were increased to a peak and then decreased with further increase in dosage until they reached almost control levels again at the dose of 100 mg/kg. Another group of animals was given equivalent doses of the vehicle in which British antilewisite was dissolved and of an inactive analog of British antilewisite (glycerin). It was shown that the effect seen was not due to either the vehicle or the inactive analog. Author

N65-25204# School of Aerospace Medicine, Brooks AFB, Tex.
PAROTID FLUID STEROID RESPONSES TO GRADED DOSES OF CORTICOTROPIN
Ira L. Shannon, John R. Prigmore (Utah Univ.), and William A. Gibson May 1963 6 p refs
(SAM-TDR-62-30; AD-415273)

Parotid fluid and urine 17-hydroxycorticosteroid (17-OHCS) measurements were carried out in 90 systemically healthy young adult males who received graded intramuscular doses of ACTH. The administration of 20, 30, and 40 units of ACTH produced significant increases in parotid fluid free 17-OHCS levels 2 hours after dosage. The 17-OHCS levels in parotid fluid following 5 and 10 units of ACTH did not differ significantly from those for the control group. The total 17-OHCS excretion rates in urine over the 6-hour experimental period showed a steady increase with the increase in dose levels. These findings strengthen the premise that parotid fluid steroid measurements may be employed in evaluating human adrenocortical status. Author

N65-25215# Naval School of Aviation Medicine, Pensacola, Fla.
SOME ISSUES IN THE DEVELOPMENT OF A MOTION SICKNESS QUESTIONNAIRE FOR FLIGHT STUDENTS
Lawrence E. Hardacre and Robert S. Kennedy 9 Mar. 1965 8 p refs
(NSAM-916; AD-463223)

Responses to an experimental motion sickness questionnaire were compared with actual motion sickness resulting from exposure to Coriolis effects at 7.5 rpm. Answers to 12 items were related to subsequent motion sickness. In an effort to ascertain honesty of responses to the questionnaire, it was administered to three groups with varying instructions. No significant differences in scores among these groups or with the experimental group above were found. Author

N65-25254# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
EFFECTS OF COLD EXPOSURE UPON THE ACTION OF THERAPEUTIC DRUGS
James Y. P. Chen and H. C. Bergman Fort Wainwright, Alaska, Arctic Aeromed. Lab., Feb. 1965 29 p refs
(Contract AF 41(609)-1989)
(AAL-TDR-64-20; AD-615490)

Based on determinations of LD_{50}, ED_{50} and therapeutic index, in mice and rats, morphine sulfate was found at least six times as toxic and three times as effective in the cold

(4°C) as at room temperature (22° to 24°C). In the rat, morphine showed a very wide margin of safety in the cold as well as at room temperature— therapeutic index, about 180. With pentobarbital, the margin of safety indicated by therapeutic index in mice and rats in the cold was only one-third that at room temperature, no significant differences were noted in the ED_{50} (median hypnotic dose) of the drug in all species tested at 4° and at 22° C. No significant differences were found in plasma concentrations of test drugs at different temperatures to account for the increased toxicity of morphine and pentobarbital in all animals studied, as well as the apparent increased efficacy of morphine in mice and rats acutely exposed to cold. Greater percentage pressor response to norepinephrine was demonstrated in dogs with or without hemorrhagic hypotension at 4° than those at 22° C. The analgesic-potentiating effect of chlorpromazine was found greater in rats in the cold than at room temperature when subeffective doses of morphine were administered simultaneously with a given dose of chlorpromazine. Clinical implications of these findings are discussed, and recommendations offered. Author

N65-25270*# Allied Research Associates, Inc., Boston, Mass.
BIBLIOGRAPHY ON BIOSENSORS. A SAMPLING OF THE WORLD LITERATURE 1960–1964. VOLUME III
J. Healer Apr. 1965 197 p refs
(Contract NASw-535)
(NASA-CR-63145; ARA-211-F-4, Pt. 2) CFSTI: HC $5.00/MF $1.50

N65-25292# Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.
ULTRAMICRO METHODS IN BIOCHEMISTRY. VII: THE DETERMINATION OF PLASMA OR SERUM UREA NITROGEN. VIII: THE DETERMINATION OF SERUM URIC ACID. IX: THE DETERMINATION OF SERUM CREATININE
E. van Stewart and Bernard B. Longwell Apr. 1965 34 p refs
(Contract AT(29-2)-1013)
(LF-22) CFSTI: $0.50

Ultramicro methods for the determination of serum urea nitrogen, uric acid, and creatinine have been evaluated and the results are recorded in reports VII, VIII, and IX, respectively. The method for the determination of urea nitrogen is an ultramicro adaptation of the reaction in which a blue color is developed when the ammonium ion reacts with phenol and hypochlorite. Ammonia is released from urea with urease. The entire reaction is conducted on 5 µl of serum or plasma and the final volume of reaction mixture is 2.205 ml. The procedure for the determination of uric acid is an ultramicro adaptation of the method which depends on the reduction of phosphotungstic acid in the presence of bicarbonate. The phosphotungstic acid reagent contains lithium sulfate as a stabilizing reagent. The reaction is conducted on 100 µl of protein free solution prepared from 20 µl of serum by precipitation with tungstic acid. Comparative analyses show very good agreement between this method and the macro procedure from which it was derived. The creatinine method is an adaptation of a standard procedure utilizing the reaction with alkaline picrate. The reaction is carried out on 100 µl of protein-free solution obtained from 40 µl of serum by precipitation of the protein with tungstic acid. The results obtained with the method are in good agreement with values obtained using the macro procedure from which the ultramicro analysis was derived. Each analytical procedure is evaluated by determination of its reproducibility, and standard deviation analyses are presented. Author

N65-25300*# Biosystems, Inc., Cambridge, Mass.
PHYSIOLOGY OF THE VISUAL CONTROL SYSTEM
Lawrence Stark, Carl Kupfer, and Laurence R. Young Washington, NASA, Jun. 1965 92 p refs
(Contract NAS2-1328)
(NASA-CR-238) CFSTI: HC $3.00/MF $0.75

The neurological aspects of the eye movement control system are investigated using experimental and analytical techniques. Specifically, it is maintained that the basic difference between version and vergence rests with the intermittency operator and the discrete control of version. Control system analytical evidence supports a central processor location for the intermittency operator as opposed to a motor or sensory one. Neuroanatomical and physiological evidence also supports a central processor locus for the intermittency operator. Possible loci hypothesized are the accessory vestibular nuclei or contiguous pontine areas. Author

N65-25344# Aerospace Medical Div. Arctic Aeromedical Lab., Fort Wainwright, Alaska.
STUDIES WITH TRITIUM (H_3)-LABELED PYRIDOXINE Technical Report, 1 Oct. 1963–1 Jul. 1964
David A. Vaughan and Robert L. Winders Mar. 1965 14 p refs
(AAL-TR-64-29; AD-462052)

The 24-hour excretion of tritium radioactivity following both large and small injected doses of tritium-labeled pyridoxine hydrochloride was investigated in rats receiving various dietary treatments. Pyridoxine deficient animals retained more of the small (12 µg) doses than did animals receiving an adequate diet. When the pyridoxine antagonist, desoxypyridoxine, was fed to the pyridoxine deficient animals, retention of the tritium-pyridoxine was reduced, indicating that the antagonist had tied up some of the tissue sites ordinarily available for pyridoxine or its derivatives. Cole exposure did not alter these relationships. Larger doses (500 µg) of pyridoxine were used less efficiently, but the absolute amounts retained suggested that the vitamin can be stored in quite large amounts. Author

N65-25401*# Massachusetts Inst. of Tech., Cambridge.
THE RESISTIVITY OF MICROORGANISMS TO THERMAL INACTIVATION BY DRY HEAT Final Report
Gerald J. Silverman and Cecil G. Dunn [1965] 17 p
(Grant NsG-691)
(NASA-CR-63198) CFSTI: HC $1.00/MF $0.50

In comparing glass fiber filters to membrane triacetate filters it was noted that the glass filters were more consistent and their average value was equivalent to about one log cycle decrease after 4 hours of exposure at 106° C. Filters removed after 10 minutes of exposure to forced and preheated air showed the anticipated decrease in spore population. Four hours of forced air at ambient temperature did not result in the loss of spores from the filter by physical removal. The membrane filter technique required a greater number of organisms to be placed on a filter as the exposure time was increased. The variation is expected to be greater until most of the variables which can affect viability are understood and controlled. Modifications in the chamber may minimize this variation. E.E.B.

N65-25425# Joint Publications Research Service, Washington, D. C.
OXYGEN CONSUMPTION BY ANIMAL TISSUES AFTER THE COMBINED ACTION OF CERTAIN GASES

S. N. Sinitsyn 7 Jun. 1965 4 p Transl. into ENGLISH from Farmakol. i Toksikol. (Moscow), no. 4, Jul.–Aug. 1964 p 470–471
(JPRS-30443; TT-65-31176) CFSTI: $1.00

The oxygen consumption by liver, brain, and lung tissues of 406 white rats weighing 150 to 250 grams was measured by Warburg's manometric method after exposure to a carbon monoxide, nitric oxide, and carbon dioxide mixture. This mixture induced more pronounced oxygen consumption changes by the tissues than the action of two constituents alone. The inhalation of 2.5% volume petroleum gas containing hydrogen sulfide dropped oxygen consumption by brain tissues 14.4%, with a return to normal after 24 hours. Inhalation of gas mixture during deep nembutal-induced sleep had no effect on brain oxygen consumption. It was concluded that a combined action of gases intensifies the impairment of oxygen consumption by tissues. The maximum permissible concentrations of individually used gases may be toxic if used in combinations.
G.G.

N65-25426# Joint Publications Research Service, Washington, D. C.
ANALYTICAL METHOD OF DETERMINATION OF SONIC PRESSURE OF DOLPHIN SIGNALS AT THE POINT OF RECEPTION
Ye. V. Shishkova 8 Jun. 1965 7 p Transl. into ENGLISH from Rybn. Khoz. (Moscow), no. 2, 1965 p 25–27
(JPRS-30466; TT-65-31183) CFSTI: $1.00

Hydrophone recording data were used to analyze sonic signals emitted by dolphins, in order to determine the value of the sonic pressure at the point of emission. A time interval of 2 seconds and more between recordings of shot-type signals and weaker secondary similar signals was attributed to echo reflections from submarine rocks or fish shoals. Values for the sonic pressures of the direct and the echo signals measured at the point of reception, and of the time interval before reception of the direct signal and the echo were used to calculate the coefficient of spatial attenuation and sonic pressure at point of emission for two recordings. It was found that the sound intensity at point of emission was higher by one order than the algesic sensation threshold for man, and it was concluded that the dolphin stunned fish by its sonic shots in order to catch them easier.
G.G.

N65-25430# Joint Publications Research Service, Washington, D. C.
PRIMARY RADIOBIOLOGICAL PROCESSES
M. I. Amiragova, N. A. Duzhenkova, M. I. Shal'nov, and A. V. Savich 10 Jun. 1965 10 p Transl. into ENGLISH from the book "Pervichnyye Radiobiologicheskiye Protsessy" Moscow, Atomizdat, 1964 288 p
(JPRS-30541; TT-65-31231) CFSTI: $1.00

The transformation of the energy of ionizing radiation in living organisms is discussed, along with the effect of radiation on (1) nucleic compounds and their low-molecular substances; (2) porphyrins and other substances important for tissue respiration; and (3) amino acids, proteins, and the role of these processes in radiation injury. A comparison of radiobiochemical and radiobiological transformation data in model systems lists the following main radiobiological effects as possible primary disturbances: (1) direct absorption of energy by the nucleoproteins leading to changes that help the process of DNA reduplication to start; (2) mutagenic action leading to changes in the DNA molecules; (3) malignant neoplasma through mutation of the somatic cells triggered by injury to the DNA matrix; (4) radiochemical reactions with substances dissolved in the cytoplasm, reversible injury to the tissue respiration system, and configurational changes in the DNA and its submolecular complexes with disruption of the intermolecular bonds; and (5) radiochemical transformations of all principal parts of the cell at 10000 rads or more.
G.G.

N65-25431# Joint Publications Research Service, Washington, D. C.
THE PROBLEM OF OXYGEN DEFICIENCY
I. R. Petrov 11 Jun. 1965 14 p refs Transl. into ENGLISH from Patol. Fiziol. i Eksperim. Terapiya (Moscow), v. 8, no. 1, Jan.–Feb. 1964
(JPRS-30576; TT-65-31250) CFSTI: $1.00

Oxygen deficiencies of dissimilar origin and the resulting pathological changes in the body systems, with emphasis on the functions of the central nervous system, are briefly summarized. It was shown that cooling, overheating, radiation sickness, and hetero- and autosensitization increases the sensitivity of the organism to oxygen deficiency, and that soporific doses of narcotics, artificial hypothermia, and ACTH increase the resistance of the organism. The basic principles of the prophylaxis and the therapy of the consequences of oxygen deficiencies taking the form of clinical death, hemorrhaging, anemia of the brain, and certain forms of poisoning are evaluated. The influence of cooling under conditions of hypoxemia and hypercapnia with its resulting rapid reestablishment of the ATP and cryophosphate content in the nerve cells is pointed out.
G.G.

N65-25448# Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex. Dept. of Microbiology
EXPERIMENTAL INFECTION OF BEAGLES WITH ECHO VIRUS TYPE 6
F. F. Pindak and W. E. Clapper May 1965 17 p refs
(Contract AT(29-2)-1013)
(LF-25) CFSTI: $0.50

Live Echo 6 virus was administered orally to six beagles previously shown by culture to be free of this agent. Some symptoms suggesting enteric disease were observed in most of the dogs. The virus was isolated from the stools of four and the blood of one, but no neutralizing antibodies could be demonstrated. Repeated intramuscular injection of live virus in six dogs produced titres as high as 1:512 and a four-fold or greater rise in all. No signs of illness were observed in those given parenteral injections.
Author

N65-25457# Joint Publications Research Service, Washington, D. C.
ALL-UNION CONFERENCE IN LENINGRAD ON AEROIONIZATION IN INDUSTRIAL HYGIENE, NOVEMBER 1963
B. B. Koyranskiy, L. Ya. Ukvol'berg, M. V. Dmitriyev, and G. S. Berezyuk 7 Jun. 1965 8 p Transl. into ENGLISH from Gigiena Truda i Prof. Zabolevaniya (Moscow), no. 10, Oct. 1964 p 60–62
(JPRS-30442; TT-65-31175) CFSTI: $1.00

A synopsis of reports discussed at the conference is presented. Among those cited were studies of theoretical and practical problems of aeroionization under industrial conditions; the use of aeroionotherapy in the treatment of bronchial asthma; and the use of aeroionization to control dust in industrial establishments, and as an air disinfectant. Also considered are studies on the effect of aeroions on the blood, the central nervous system, cerebrocortical functions, and gastric secretions. Among the new methods of generating and

calculating aero- and hydroions are the use of counters for geophysical measurements and of wire antennas, fed by an apparatus for franklinization, for ionizing the air of large rooms; and the ultramicroscopy of electrically charged aerosols for determining the concentration of dust particles. S.C.W.

N65-25458# Joint Publications Research Service, Washington, D. C.
DETERMINATION OF THE FRACTIONING COEFFICIENTS AND THE BIOLOGICAL AVAILABILITY OF THE PRODUCTS OF NUCLEAR EXPLOSIONS IN RADIOACTIVE FALLOUTS
Yu. A. Izrael' 8 Jun. 1965 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Mat., Fiz. (Moscow), v. 161, 1965 p 343–346
no. 1–3 1965 p 343–346
(JPRS-30500; TT-65-31211) CFSTI: $1.00

The distribution density of radioactive products on large spherical particles (with a diameter greater than 10 to 20μ), forming as a result of surface explosions is discussed. Also considered are air explosions in which the formation of particles occurs as a result of condensation of evaporating bomb matter and coagulation of submicron particles. Included is a method for determining the dependence of coefficients of fractionation and biological contamination on particle size. Results of determinations for the isotopes Sr^{90} and Ba^{140} with respect to the isotope Zr^{95} are reported. S.C.W.

N65-25459# Joint Publications Research Service, Washington, D. C.
THE DANGERS OF ANESTHESIA AT HIGH ALTITUDES
Yu. I. Datkhayev 11 Jun. 1965 7 p refs Transl. into ENGLISH from Eksperim. Khirur. i. Anesteziol. (Moscow), no. 2, Mar.–Apr. 1964 p 61–64
(JPRS-30577; TT-65-31251) CFSTI: $1.00

Under high-altitude conditions of hypoxia, ether anesthesia in combination with air is not recommended for wide use, especially during major and prolonged abdominal operations. The anesthetization of patients by the stunning method (a rapid increase of the dosage of ether in the inhaled air) is impermissible under high-altitude conditions. The lingering character of the saturation phase of anesthesia at high altitude is often accompanied by prolonged vomiting. Evacuation of the stomach of patients prior to anesthetization increases the safety of the latter. The slightest complication of external respiration during anesthetization and in the postanesthesia period, under conditions of high-altitude hypoxia, very often leads to an undesired strain on the respiratory and circulatory apparatus. Under conditions existing at high altitudes it is necessary to consider the possibility of prolonged apnea after the administration of curare compounds. Author

N65-25529# Philco Corp., Willow Grove, Pa. Bio-Cybernetics Lab.
A CORRELATIONAL STUDY OF MYOPOTENTIAL RESPONSE AND FORCE OF MUSCLE CONTRACTION DURING VARYING ACTIVITY DEMANDS Interim Report
F. Ray Finley and Roy W. Wirta 17 Mar. 1965 33 p refs
(Contract Nonr-4292(00))
(Rept.-2386; AD-613930)

A major objective of the Philco biocybernetics engineering activity has been to develop an optimum degree of compatibility between man and the machines which he used to augment his performance capacity. One phase of study, in the pursuit of this objective, has been developed about a hypothesis that the myoelectric activity associated with muscular contraction could be utilized to control a powered exoskeletal system designed to amplify one's strength. This phase of study is the subject of this interim report. TAB

N65-25540 Joint Publications Research Service, Washington, D. C.
SECOND SYMPOSIUM ON BIOTELEMETRY HELD IN SVERDLOVSK
V. V. Parin and V. V. Rozenblat 9 Jun. 1965 7 p Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 50, no. 9, Sep. 1964 p 1191–1193
(JPRS-30528; TT-65-31226) CFSTI: $1.00

A synopsis of reports discussed at the second symposium on biotelemetry, which focused on the use of radiotelemetry in physiological and medical research, is presented. Included are data on the general aspects of radiotelemetry in physiology and medicine, the technological and methodological aspects of radiotelemetry, and results of experimental radiotelemetric research. Among the reports presented were an analysis of problems in classifying biotelemetric systems, the use of biotelemetry in aerospace medicine, the development of separate units in radiotelemetric systems, methods of recording body and skin temperature, the use of biotelemetric data for investigating spacecraft control systems; and results of pathophysiological studies of man and experimental animals which emphasized the use of radioelectrocardiographic and radiopulsometric data in determining pathological shifts. S.C.W.

N65-25541# Joint Publications Research Service, Washington, D. C.
TRANSISTORIZED DIRECT CURRENT MILLIVOLTMETER FOR BIOLOGICAL RESEARCH
V. A. Mayskyy 10 Jun. 1965 10 p refs Transl. into ENGLISH from Fiziol. Zh. Akad. Nauk Ukr. RSR (Kiev), v. 11, no. 2, 1965 p 265–268
(JPRS-30557; TT-65-31239) CFSTI: $1.00

The development of a transitorized direct current millivoltmeter, which consists of a simple transitorized alternating current amplifier and compact silicon stabilitron converters, is reported. The circuitry is described, and the requirements of the clock pulse generator are discussed. Illustrated is an electrical diagram and a general view of the instrument. S.C.W.

05 BIOTECHNOLOGY

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N65-24418# Pittsburgh Univ., Pa.
PROGRAMMING METHOD AND RESPONSE MODE IN A VISUAL-ORAL TASK Final Report, Oct. 1961–Oct. 1963
Attila P. Csanyi, Robert Glaser, and James H. Reynolds
Wright-Patterson AFB, Ohio, AMRL, Dec. 1964 19 p refs
(Contract AF 33(616)-7175)
(AMRL-TR-64-129; AD-614014)

Programing methods and response modes were investigated to determine effective training methods. The identification and pronunciation of phonetic symbols were taught by two different programing methods and two different response modes. The programing method featured either prompting or confirmation, and the response mode was either overt or covert. Achievement was measured on both a multiple choice test and a test requiring overt oral responses. Considerable variation occurred among the test scores for each learning condition. Differences among the conditions, tending to indicate the superiority of overt responding and of

confirmation, were significant on only one case. Overt responding was superior for retention when measured by tests requiring overt oral responses. The prompting method coupled with the covert response mode tended to produce poorer learning and retention than the other conditions, but it required only 30 to 50 percent as much learning time as the other conditions. Author

N65-24696# Joint Publications Research Service, Washington, D. C.
THE ENDURANCE BARRIER OF PILOTS
S. P. Umanskiy 2 Jun. 1965 25 p Transl. into ENGLISH from "Bar'yer Vynoslivosti Letchika" Moscow, 1964 p 97–120 (JPRS-30380; TT-65-31143) CFSTI: $1.00

Aviation technological improvements made in protective clothing, ejection seats, and parachutes to increase the constitutional endurance of pilots in flight or in case of emergency escape are presented. The history of the antigravity suit and safety helment is given, showing how basic improvements were made in their design and construction. R.C.S.

N65-24710# Lockheed Missiles and Space Co., Sunnyvale, Calif.
AN INTEGRATED APPROACH TO EVALUATING THE PERFORMANCE CAPABILITIES AND PHYSIOLOGICAL STATE OF SPACECRAFT CREWS
R. S. Lincoln and J. E. Mangelsdorf 28 Apr. 1965 25 p refs Presented at the Symp. on Human Physiol. and Performance Determinants of Manned Space Systems Design, San Fernando Valley State Coll., Calif, 14 Apr. 1965
(LMSC-6-65-65-15)

A development project concerned with all major aspects of crew monitoring, from the development of measurement techniques to the interpretation of processed data, was initiated. The objectives of the project are: (1) to develop an automatic system to assist in monitoring crew performance capabilities and physiological state, and (2) to develop digital techniques for processing, displaying, and analyzing obtained data. Author

N65-24861# Joint Publications Research Service, Washington, D. C.
MEDICO-BIOLOGICAL STUDIES OF FLIGHT CONDITIONS AND TRAINING
11 May 1965 13 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 3, Mar. 1965 p 34–40
(JPRS-29999; TT-65-30951) CFSTI: $1.00

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N65-24862 Joint Publications Research Service, Washington, D. C.
EXPERIMENTS WITH GRAVITY LOAD AND WEIGHTLESSNESS
N. Gurovskiy and M. Cherepakhin *In its* Med.-Biol. Studies of Flight Conditions and Training 11 May 1965 p 1–4 (See N65-24861 14-05) CFSTI: $1.00

Six of 25 subjects exposed to weightlessness of 18 to 25 seconds followed by weight loads up to two G's for 5 to 10 seconds in the course of parabolic flights, expressed negative psychological and physiological reactions, and four test subjects reacted with a heightened emotional tone. Subsequent flights failed to induce significant vegetative reactions in persons who had reacted negatively to weightlessness during the first flights. The reaction in all subjects fairly adapted close to indifference during further flights. G.G.

N65-24863 Joint Publications Research Service, Washington, D. C.
MORE EXACT FLIGHT SIMULATION IN THE TRAINER
Ye. Derevyanko, V. Kuznetsov, and V. Myl'nirov *In its* Med.-Biol. Studies of Flight Conditions and Training 11 May 1965 p 5–8 (See N65-24861 14-05) CFSTI: $1.00

Moving pictures taken of a pilot's gaze in actual flight and in trainers show a limitation to observations of the gyrohorizon, the vertical speed indicator, gyrocompass, airspeed indicator, and altimeter. It was concluded that a specially directed training session is necessary to evaluate the flight situation in a timely and accurate manner and to determine specific gage failures. The pilots psycho-physiological reserves should be determined in the trainer by deactivation of a light bulb in a light cluster positioned on the instrument panel. This method intensifies the pilots activity and makes it possible for the flight surgeon and unit commanders to find shortcomings in pilot training and to study individual pilot traits. G.G.

N65-25002*# Case Inst. of Tech., Cleveland, Ohio.
[INVESTIGATION OF CONTROL IN MAN–MACHINE SYSTEMS WITH EMPHASIS ON PROBLEMS OF REMOTE MANIPULATION] Progress Report, 1 Aug. 1964–31 Jan. 1965
14 May 1965 21 p Includes paper presented at 6th Ann. Symp. of the Profess. Group on Human Factors in Electron., The Inst. of Elec. and Electron. Engr., 6–8 May 1965
(Grant NsG-728)
(NASA-CR-62878) CFSTI: HC $1.00/MF $0.50

A technique for applying numerical control to a remote manipulator to allow the operation to divert more attention from the machine to the assigned task is presented. Ideally the operator should specify only the destination, but this does not determine a unique path. An algorithm is devised for computer calculation of the optimal path from point of origin to point of destination; the program is given the start point and gradient for the hand, and initial path parameters, and it calculates the machine variables for 100 steps along the path. Analysis of computer simulation runs indicates that the point-to-point optimization approach becomes less satisfactory as length and complexity of the path increases, but the speed of path generation and its short-path performance suggests that a modification of the program may lead to acceptable paths. J.M.D.

N65-25051 Joint Publications Research Service, Washington, D. C.
EXPERIMENT OF THE PHYSIOLOGICAL ANALYSIS OF THE SOLUTION OF CONTROL PROBLEMS BY A PERSON
Ye.V. Voloshinova *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 253–266 refs (See N65-25031 14-10)
CFSTI: $8.28

The human dynamics of forming systems of temporary connections which ensure control of complicated processes are investigated. In experiments on solution of control problems, human subjects were exposed to quantitative information which varied according to certain differential equations, and they were instructed to maintain specified gage levels by manipulating a control stick, and then to formulate hypotheses concerning the pattern of change in the input data. The physiological aspects of the learning process involved in these tests

are analyzed, particularly the phenomena of visual and motor adaptation. J.M.D.

N65-25269*# Northrop Space Labs., Hawthorne, Calif.
ANALYTICAL REVIEW OF PASSIVE MASS TRANSFER OF WATER VAPOR IN A SPACE SUIT
Joseph A. Peterson, Constantino Cafaro, Arnold P. Shlosinger, and Kay F. Sterrett May 1965 56 p refs
(Contract NAS2-2102)
(NASA-CR-63144; NSL-65-87-1) CFSTI: HC $3.00/MF $0.50

This report presents results of an engineering study and analysis to determine the feasibility of transporting water vapor from the skin of an astronaut through an oxygen–water vapor mixture filled gap and on to a surface capable of adsorbing or condensing and removing the moisture in a space suit. A desiccant bed or a wick cooled below the required dew point were devices considered for adsorbing or condensing and retaining or removing the moisture. The theoretical analysis of binary diffusion coefficients indicates that the rate of diffusion across a gap is adequate for application in a space suit. The thermal diffusion coefficient was found to have no significant effect upon the diffusion rate in the space suit. Application of the derived design criteria for desiccant beds indicates their feasibility in removing water vapor for limited time periods. The concept of condensing on a cooled wick appears feasible for application to extended periods of time. The analysis of condensing on cooled wicks requires experimental input parameters and a digital computer solution to provide numerical performance data. Direct empirical determination of these performance data appears more practical than experimental input parameter determination and computer analysis. Author Author

N65-25341# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ARTIFICIAL RAISING OF AIR PRESSURE
M. J. Pavlok 1 Apr. 1965 9 p Transl. into ENGLISH from Spec. Hyg. Letce (Czechoslovakia), 1954 p 24–27
(FTD-TT-65-258/1+2; AD-460454)

Several flight suits that were developed prior to the introduction of pressurized cabins are described. Various experiments have shown that the flying suit cannot be a definite solution for the prevention of hypoxia at high altitudes. Principles of increasing the pressure artificially originated on stratospheric balloon gondolas, and were later applied to the construction of cabins of rocket aircraft for flights into the stratosphere. Pressurized cabins are now in use on many aircraft with a wide range of altitude above sea level and are a great contribution to the struggle against hypoxia, permitting higher aircraft ceilings. R.W.H.

N65-25435 Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
FIELD EVALUATION AND CONTROL OF PERSONNEL BEHAVIOR
R. J. Nertney Apr. 1965 31 p ref
(Contract AT(10-1)-205)
(IDO-17074) CFSTI: $2.00

This paper presents considerations in performing human factor studies in a relatively unperturbed working environment and outlines certain programs. Working group indices were established based on specific organizational objectives by management. The ability of the organization to fulfill these objectives is sampled by staff evaluators on a "did do" or "did not do" basis. Reduction to simple dichotomy makes use of quality control techniques possible and provides useful numerical indices for evaluation and control of personnel behavior under field working conditions. Author

N65-25514# Joint Publications Research Service, Washington, D. C.
SPEECH, ARTICULATION, AND PERCEPTION
V. A. Kozhevnikova and L. A. Chistovich 10 Jun. 1965 272 p refs Transl. into ENGLISH of the book "Rech', Artikulyatsiya, i. Vospriyatiye" Moscow-Leningrad, 1965 p 1–241
(JPRS-30543; TT-65-31233) CFSTI: $6.00

Results are presented of an original experimental investigation of the speech process conducted by a group of physiologists, linguists, mathematicians, and engineers. New methods are described for the investigation of the activity of the speech-forming mechanism, based on the application of modern electronic technology. New theoretical concepts are advanced relative to the organization of the speech perception processes. The research findings are considered against the background of the problems associated with man's communicating with electronic computers. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N65-24403# Manlabs, Inc., Cambridge, Mass.
ANALYTICAL STUDY OF THE THERMODYNAMIC FACTORS CONTROLLING DIAMOND SYNTHESIS AND GROWTH AT HIGH PRESSURES AND TEMPERATURES Final Report, 1 Dec. 1962–31 Jan. 1965
Edward T. Peters, Laurence Kaufman, and John J. Ryan Bedford, Mass., AFCRL, Feb. 1965 62 p refs
(Contract AF 19(628)-2466)
(AFCRL-65-168; AD-614082)

A method for predicting a priori the conditions for indirect diamond synthesis, i.e., synthesis via a metal catalyst or solvent, was developed. The method is based upon thermodynamic calculation of the high pressure phase equilibria for a given metal–carbon system, in which the liquid phase is approximated as a regular solution, i.e., a linear dependence of the volume of liquid metal–carbon alloys with composition has been assumed. Calculations were carried out for the nickel–carbon and manganese–carbon phase equilibria, representing noncarbide forming and carbide forming systems (at 1 atmosphere pressure), respectively. For comparison to the calculations, the eutectic temperature of the nickel–carbon system was measured experimentally at 40 kb pressure by means of in situ electrical resistances vs. temperature measurements and post mortem metallographic observations; the calculated and experimental values are in agreement. Comparison of the calculated nickel–carbon phase equilibria with the experimental diamond synthesis data of other workers indicates that the lower temperature-pressure limits for indirect diamond synthesis are controlled by the eutectic temperature at pressure and the diamond-graphite equilibrium line. Author

N65-24406# Army Electronics Labs., Fort Monmouth, N. J. Power Sources Div.
THE EFFECT OF CARBONATED ELECTROLYTE ON THE PERFORMANCE OF SINTERED PLATE NICKEL–CADMIUM CELLS
Paul J. Rappaport Feb. 1965 12 p refs
(ECOM-2559; AD-614104)

The effect on the capacities of positive and negative limiting sintered plate Ni–Cd cells of varying the KOH/K_2CO_3 ratio of an electrolyte which is approximately 7 *N* in total alkalinity

is reported. K_2CO_3 contents of 24, 71, and 238 g/l were investigated. Data are also presented on the specific resistance of various KOH–K_2CO_3 solutions over the temperature range of 86° to −40° F. There was no marked difference in performance of either positive or negative capacity limiting cells with electrolyte containing 24 or 71 g/l of K_2CO_3. However, there was an appreciable adverse effect on the performance of cells when the carbonate content was 238 g/l K_2CO_3, particularly for the negative capacity limiting cells. From the results of the capacity and specific resistance measurements, it is recommended that the maximum allowable carbonate content for the electrolyte in sintered plate Ni–Cd cells be set at 100 g/l K_2CO_3. Author

N65-24423# Battelle Memorial Inst., Columbus, Ohio.
MEASUREMENT OF TRUE SURFACE AREA IN ELECTRODES First Quarterly Technical Progress Report, 15 Dec. 1964–15 Mar. 1965
J. Mc Callum, J. F. Walling, and C. L. Faust 2 Apr. 1965 22 p refs
(Contract AF 33(615)-2225)
(BATT-7138-Q-1; AD-613299)

Reported is a program designed to develop an electrochemical method for determining surface areas in porous electrodes. Presented are preliminary results of initial studies on three possible approaches to area measurements on single uniform pores and capillaries. Although double-layer capacitance was selected for initial study, the effects of diffusion, adsorption, and filming will be kept in mind for possible independent checks of true surface area in porous electrodes. Geometric effects on capacitance are investigated, both theoretically and experimentally. The theoretical prediction is that double-layer capacitance in porous electrodes may be treated as flat-plate capacitors, providing the radii of the small pores are larger than about 100 Å. Pertinent experimental techniques are reviewed. The use of fast response pulses appears to hold the most promise for successful estimation of true surface area. Author

N65-24425# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.
A LOWER STANDARD ELECTRON ENERGY FOR ANALYTIC MASS SPECTROSCOPY Technical Report, Jul.–Dec. 1963
Donald J. Dunbar and L. A. Harrah Feb. 1965 41 p
(AFML-TR-64-381; AD-613642)

Ten mass spectra from each of twelve compounds including methane, n-butane, 2-butyne, 1-butene, iso-butene, diethyl ether, benzene, ethanol, iso-pentane, ethyl iodide, toluene, and ethyl acetate were obtained using the Bendix time of flight mass spectrometer. The spectra from each compound were obtained at 15, 17, 20, 25, 30, 35, 40, 50, 70, and 100 volts electron bombarding energy. Representative ionization efficiency curves are plotted from each compound. Other spectra are discussed, and recommendations are made for electron bombarding energies to be used in analytic spectroscopy with the Bendix time of flight instrument. Author

N65-24440# Bureau of Mines, Boulder City, Nev. Boulder City Metallurgy Research Lab.
ELECTROREFINING URANIUM IN A CHLORIDE ELECTROLYTE
R. E. Campbell and T. A. Sullivan 1965 18 p refs
(BM-RI-6624)

Uranium metal of improved purity was prepared by electrorefining commercial magnesium-reduced uranium in a molten sodium chloride–uranium trichloride electrolyte. The best operating conditions for the preparation of refined metal were established as follows: an electrolyte containing 8.7 to 13.3 wt% uranium; initial cathode densities from 300 to 1500 A/ft^2; and a molten salt temperature of 860° C. Ingots produced from electrorefined uranium crystals prepared with these operating conditions were substantially free of metallic impurities. The only impurities in the refined and consolidated metal were present in low or undetectable amounts. Author

N65-24452# Temple Univ., Philadelphia, Pa. Research Inst.
ADDITION AND SUBSTITUTION PRODUCTS OF OXYGEN FLUORIDES Annual Progress Report, 1 Jan.–31 Dec. 1964
Alex G. Streng and Aristid V. Grosse 5 Jan. 1965 54 p refs
(Contract Nonr-3085(01))
(APR-5; AD-613448)

New oxygen fluorides with oxygen content higher than in previously prepared O_xF_y compounds obtained were $O_{4.7}F_{2.0}$, $O_{4.9}F_{2.0}$ and $O_{6.0}F_{2.0}$. Method of preparation of O_4F_2 was improved and these properties of tetraoxygen difluoride were determined: melting point, 82° ±2° K.; normal boiling point, 194° K.; vapor pressure, $\log P_{mm} = 5.9–585/T$; thermal stability; solubility in liquid nitrogen, oxygen and Freons; molar extinction coefficients in the visible range and EPR spectrum. Method of chemical analysis of O_4F_2 is given. New data on characterization of oxygen fluorides were obtained. Molar extinction coefficients and epr spectrum of OF_2 were determined. Thermal stability, vapor pressure and absorption and epr spectra of all the oxygen fluorides are compared. Absorption of the visible light of liquid OF_2 is found negligible in comparison with that of the other oxygen fluorides. The O_4F_2 showed the highest absorbance, with a peak at 400 mμ. OF_2 and O_2F_2 are essentially diamagnetic, while O_3F_2 and O_4F_2 are highly paramagnetic. Concentration of the paramagnetic species in O_3F_2 is 5 to 10 mole%, and in O_4F_2, > 10 mole%. Reaction of oxygen difluoride with xenon at room temperature and ordinary pressure leading to XeF_2 is described. New information on noble gas fluorides is presented, and the use of noble gas fluorides as possible igniters for rocket propellants is explored. Author

N65-24472# Rice Univ., Houston, Tex. Dept. of Chemistry
RESEARCH IN FLUORINE CHEMISTRY Progress Report, 1 Oct.–31 Dec. 1964
John L. Margrave [1964] 8 p refs
(Contract DA-31-124-ARO(D)-110; ARPA Order 40)
(PR-6; AD-456534)

Continued research in fluorine chemistry is reported. Included are data on fluorine bomb calorimetry, vapor pressures of fluorides, high temperature heat contents and entropies of fluorides, and the synthesis of new fluorine compounds. Also reported is the design of an induction heated furnace for the calorimeter which operates at temperatures slightly higher than 2000° K. S.C.W.

N65-24493# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 178
10 May 1965 73 p refs
(JPRS-29987; TT-65-30944) CFSTI: $3.00

CONTENTS:

1. ADHESION BETWEEN NATURAL RUBBER AND SOFT POLYVINYL CHLORIDE Chen-yun Lu and Chih-lu Wang p 1–7 refs (See N65-24494 14-06)

2. CALCULATION BY DIAGRAM OF MAXIMUM YIELD IN CHEMICAL REACTIONS IN EQUILIBRIUM Ta-chun Lu p 8–16 refs (See N65-24495 14-06)

3. PREVENTION OF CORROSION IN THE ULTRATHERMOSTAT Pao-ting Hua and Hsing-su Chen p 17–18

4. A METHOD OF RECOVERING PYRIDINE FROM ITS MIXTURE Tsung-mu Wang p 19–22 refs

5. THE ROLE OF DISLOCATION IN SOME CHEMICAL REACTIONS OF SOLIDS Chien-ch'i Wang and Tzu-hsi Chu p 23–49 refs (See N65-24496 14-06)

6. PREPARATION OF A pNa ELECTRODE Yu-sheng Su p 50–67 refs (See N65-24497 14-06)

7. THE FIRST ALL-CHINA SYMPOSIUM ON ALGOLOGY Hung-chih Chin p 68–70

N65-24495 Joint Publications Research Service, Washington, D. C.

CALCULATION BY DIAGRAM OF MAXIMUM YIELD IN CHEMICAL REACTIONS IN EQUILIBRIUM

Ta-chun Lu *In its* Transl. on Communist China's Sci. and Technol., No. 178 10 May 1965 p 8–16 refs Transl. into ENGLISH from Hua-hsueh T'ung pao (Peking) p 53–56 (See N65-24493 14-06) CFSTI: $3.00

A method is presented for the determination by diagrams of the maximum yield for chemical reactions at equilibrium. Also, an example is provided for the reaction

$$N_2 + 3H_2 \leftrightarrows 2NH_3$$

at 400° C, K_p = 0.000164, and total pressure of the system = 10 and 50 atmospheres, respectively. The maximum yield was calculated for 10 atm, NH_3 = 3.85%; and at 50 atm, NH_3 = 15.0%. Results are given for both calculated yield and those found from the diagram method. In general, good agreement between calculated values and those from the diagram was obtained. E.E.B.

N65-24496 Joint Publications Research Service Washington, D. C.

THE ROLE OF DISLOCATION IN SOME CHEMICAL REACTIONS OF SOLIDS

Chien-ch'i Wang and Tzu-hsi Chu *In its* Transl. on Communist China's Sci. and Technol., No. 178 10 May 1965 p 23–49 refs Transl. into ENGLISH from Hua-hsueh T'ung-pao (Peking), no. 10, 14 Oct. 1964 p 11–21 (See N65-24493 14-06) CFSTI: $3.00

The mechanism and functioning of dislocation in the chemical reactions of solids are discussed. Fundamental concepts and application to photolysis of AgBr, adsorption, catalysis, polymerization, and other reactions of the solid phase are considered. E.E.B.

N65-24497 Joint Publications Research Service, Washington, D. C.

PREPARATION OF A pNa ELECTRODE

Yu-sheng Su *In its* Transl. on Communist China's Sci. and Technol., No. 178 10 May 1965 p 50–67 refs Transl. into ENGLISH from Hua-hsueh T'ung-pao (Peking), no. 10, 14 Oct. 1964 p 44–49 (See N65-24493 14-06) CFSTI: $3.00

A method is described for the preparation of a sodium electrode with an internal resistance of 7 megohms at room temperature. The activity of sodium ions was then determined by relating the potential to the activity of sodium ions in solution. It was found that within the range of 1 to 0.0001 molar, a good linear relationship exists between the electrode potential and the negative logarithm of sodium ion activity. E.E.B.

N65-24590# Ethyl Corp., Baton Rouge, La.

RESEARCH ON LIGHT METAL FUELS AND OXIDIZER CHEMISTRY. PART II: OXIDIZER CHEMISTRY Quarterly Progress Report No. 6, Nov. 1964–Jan. 1965

W. E. Becker, D. H. Campbell, and F. J. Impastato [1965] 15 p refs

(Contract AF 04(611)-9376; ARPA Order 24)

(EC-751; AD-461709)

Investigation of the D_2O–HNF_2 exchange reaction was completed. Rate data obtained at 0°, −10° and −20° were used to calculate activation energy, 4.5 kcal/mole. This kinetic data allowed calculation of the first-order rate constant for the HNF_2–CF_3COOD exchange at temperatures used; by subtraction of this contribution from the total rate, the second-order rate constants were calculated. An activation energy of 26.0 kcal/mole was calculated for this second-order reaction. Additional conductance studies of $ClNF_2$ in nitrobenzene gave inconclusive results. Conductivity data were not reproducible, and the low level of conductance observed can be accounted for by assuming the presence of trace impurities arising from trace reactions of $ClNF_2$ with the solvent or impurities in the solvent. Author

N65-24632# Phillips Petroleum Co., Idaho Falls, Idaho.

ANNUAL REPORT OF DIVISION ANALYTICAL BRANCH FOR 1964

Ralph C. Shank et al Apr. 1965 213 p refs

(Contract AT(10-1)-205)

(IDO-14655) CFSTI: $6.00

Projects of interest to analytical chemists are presented. To make the report more useful to those who submit samples, it is organized by projects rather than by analytical disciplines. Newly developed or updated analytical methods are discussed. Author

N65-24633# Dow Chemical Co., Denver, Colo. Chemistry Research and Development Labs.

RAPID DETERMINATION OF ALUMINUM IN PLUTONIUM PEROXIDE CAKE

H. N. Barton 2 Oct. 1964 11 p ref

(Contract AT(29-1)-1106)

(RFP-424) CFSTI: $0.50

A carrier distillation spectrochemical method was successfully adapted to direct reading spectrometry. Direct reading techniques were developed for the rapid analyses of aluminum in plutonium peroxide to demonstrate the capability of direct reading for process impurity control. Author

N65-24635# European Atomic Energy Community, Brussels (Belgium).

APPLICATION OF ELECTROCHEMICAL METHODS TO NEUTRON ACTIVATION ANALYSIS [STUDIO SULL'APPLICAZIONE DI METODI ELETTROCHIMICI IN ANALISI PER ATTIVAZIONE]

C. Bigliocca, F. Garardi, and J. Pauly Feb. 1965 14 p refs In ITALIAN; ENGLISH summary

(EUR-2165.i) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

Application of electrochemical methods to neutron activation analysis was studied, with particular reference to controlled potential deposition and spontaneous deposition on mercury amalgams. Factors influencing these processes were considered. Electrochemical techniques were then applied to problems of interest in neutron activation analysis: zinc–cadmium and copper–antimony separations, trace analysis of aluminum, determination of antimony in presence of copper, and removal of a highly active copper matrix. Author

N65-24709# Argonne National Lab., Ill. Chemical Engineering Div.

ENGINEERING DEVELOPMENT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART 7: THE CORROSION OF NICKEL IN PROCESS ENVIRONMENTS

A. A. Chilenskas and G. E. Gunderson Mar. 1965 18 p refs
(Contract W-31-109-ENG-38)
(ANL-6979) CFSTI: $1.00

Corrosion studies in support of the fluoride volatility program are in progress using small-scale laboratory tests conducted in tube furnaces, and inplant exposure tests. Results of both types of tests show the following: (1) Under conditions of low gas flow rates, where protective films easily form, corrosion rate of nickel by fluorine alternated with hydrogen chloride and fluorine alternated with oxygen is low (1–4 mils/yr) and in agreement with that of nickel for fluorine alone. (2) Where films form less readily or can be removed upon being formed, corrosion rate is significantly higher than under static conditions, but less than would occur if no protective film formed. Corrosion rate of nickel is shown to increase due to the presence of a fluidized bed. (3) Under static conditions for long-term exposure, welds made with nickel-200 metal filler were shown superior to those made with nickel-61 filler metal and corrosion rates of welds made with nickel-200 range from 1 to 5 mils/yr (comparing closely with corrosion rate for nickel plate, while welds made with nickel-61 filler metal ranged from 67 to 1315 mils/yr. Some evidence indicates a small amount of titanium in nickel filler metal-61 causes high corrosion rates. (4) Specimens examined metallographically exhibited little or no evidence of intergranular attack. Several specimens from inplant tests showed a few areas where apparent intergranular attack of 1 to 2 mils occurred. (5) Thermal cycling of a specimen exposed to process environments had little or no effect upon corrosion rate; neither did exposure of specimen to air after each process cycle. Author

N65-24754# Wayne State Univ., Detroit, Mich. Dept. of Chemistry
A GENERALIZATION OF THE DEBYE LIGHT SCATTERING EQUATION
Wilfried Heller 3 Dec. 1964 7 p refs Submitted for Publication
(Contract Nonr-3511(00))
(TR-12(58); AD-609962)

The Debye light-scattering equation is generalized by making allowance for the variation of (dn/dc), and therefore of H, with the concentration of the solute. This should allow one to use it with more concentrated solutions, provided light scattering is weak enough (oligomer solutions) so that multiple scattering does not exclude such a procedure. Author

N65-24757# Sandia Corp., Albuquerque, N. Mex.
PROPERTIES OF MOLECULAR SIEVE-TYPE DESICCANTS
George Voida May 1965 38 p
(SC-RR-65-160) CFSTI: $2.00

Water-vapor adsorption properties of molecular sieve desiccants when exposed at several different test humidities are reported. The thermal stability and also the decay characteristics of the desiccants after numerous reactivation cycles are presented. Glass cloth bags used in the packaging of regenerable desiccant units illustrate specific advantages in analytical investigations and in end-applications. The effectiveness of molecular sieve desiccants in the drying of rigid polyurethane foams is described. Preliminary studies of desiccant drying of internal atmospheres indicate the need for more extensive experimental work. The water-vapor transmissibility of various commercial plastic films was also determined. Author

N65-24808# Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.
DESIGN CRITERIA FOR ADVANCED PROPELLANT SYSTEMS Final Report, 1 Jul. 1963–31 Jul. 1964
Andrew Lum and Michael Mc Allister Edwards AFB, Calif., AF Rocket Propulsion Lab., Jan. 1965 69 p refs
(Contract AF 04(611)-8400(S))
(AFRPL-FR-64-149; AD-460526)

The compressibility factor, density, viscosity, and heat capacity of gaseous fluorine were measured over a wide range of temperatures and pressures. The original goal was to examine the temperature range from −306° F to +200° F at a pressure of 100 to 300 psia, but this was not always possible. In such cases, extrapolations of measured data were made over the required range. These extrapolations should be quite valid, since fluorine has been found to behave as a normal diatomic molecule. Author

N65-24809# IIT Research Inst., Chicago, Ill. Technology Center
OPTICAL SPECTRA USING THE MATRIX ISOLATION TECHNIQUE Quarterly Technical Summary Report, Nov. 14, 1964–Feb. 14, 1965
Alan Snelson [1965] 11 p refs
(Contract DA-31-124-ARO(D)-111; ARPA Order 458)
(IITRI-C6013-7; AD-458533)

Thermodynamic functions of low-molecular-weight compounds formed in the exhaust gases of rocket motors are being obtained using spectroscopic techniques. The spectrum of lithium fluoride trapped in neon matrices was defined using isotopes of lithium fluoride containing greater than 99% Li^6 and Li^7. Measurements were made on 10 spectra at varying peak intensities, and a constancy to within ±5% was obtained. Due to the molecular symmetry of the B_{1u} bending mode it was possible to apply the sum rule to test the assignment of the absorption at 300 cm^{-1} to the bending mode. Agreement to within 0.3% supports the previous assumption that these bands correspond to the bending mode of the dimers. An attempt was made to observe all six frequencies of the mixed isotopic species $Li^6Li^7F_2$ and to determine if any new bands were related to the previously assigned dimer bands using relative intensity comparisons. Measurements were also made on the spectra in which the halide was deposited under a variety of conditions. The best values for the B_{1u}, B_{2u}, and B_{3u} vibration frequencies for the $Li_2{}^7F_2$ molecule were 289, 561, and 653 cm^{-1}, with an estimated error of +3%. Author

N65-24813# Monsanto Research Corp., Everett, Mass. Boston Lab.
RESEARCH TO IMPROVE ELECTROCHEMICAL CATALYSTS Semiannual Progress Report No. 1, 15 Jun.–30 Dec. 1964
J. O. Smith, J. C. Orth, M. C. Deibert, S. Matsuda, J. J. O'Connell et al 15 Jan. 1965 53 p refs
(Contract DA-49-186-AMC-166(X))
(MRB-4020S1; AD-461088)

Twenty-three metal chelate compounds were prepared, purified, and tested as fuel cell catalysts for hydrogen, methanol, hydrazine, propane, acetate, and formate fuel cell anodes. A gas electrode of a Teflon matrix with carbon or metal powder was developed. This electrode has excellent mass transport properties and is being used to evaluate chelate catalysts. With this structure, chromium and palladium phthalocyanines show good hydrogen electrode activity when the chelate is wet-mixed with carbon. Addition of adsorbing agents (silica and squalene) further improves performance. Author

N65-24820# Pennsylvania Univ., Philadelphia. Electrochemistry Lab.
[ELECTRO CATALYTIC OXIDATION PROCESSES OF ETHYLENE AND OTHER HYDROCARBONS ON PLATINUM AND VARIOUS OTHER METALS AND ALLOYS] Interim Technical Progress Report, 7 Feb.–6 Nov. 1964
E. Gileadi, B. Piersma, A. Damjanovic, B. Rubin, and J. O'M. Bockris Jan. 1965 101 p refs
(Contract DA-44-009-AMC-469(T))
(AD-612252)

Using a new method for determining the extent of adsorption from solution onto solid metal electrodes, the potential, concentration, and temperature dependence of the adsorption of ethylene on a platinized gold electrode was investigated. Results show: (1) The peak potential shifts slightly in the cathodic direction with increasing coverage. (2) The equilibrium constant for adsorption is essentially independent of temperature in the range of 30° to 70° C. (3) A positive standard entropy of adsorption occurred which was consistent with the water displacement mechanism. (4) The rate of adsorption is diffusion controlled. Also studied was the current potential relationship of ethylene oxidation on platinum, palladium, rhodium, iridium, and gold, and on alloys of Pt with Rh, Pt with Ir, and Pt with Au. Included are preliminary studies of the oxidation of C_2H_4 in alkaline solution on non-noble metals such as nickel and silver. The effect of different crystal planes of Pt single crystals on current potential for the same reaction is also examined. S.C.W.

N65-24827# Martin Co., Baltimore, Md. RIAS Div.
THEORETICAL AND QUANTUM CHEMISTRY OF N, O, F COMPOUNDS Quarterly Technical Report, 9 Jan.–9 Apr. 1965
Joyce J. Kaufman [1965] 36 p refs
(Contract DA-31-124-ARO-D-203; ARPA Order 542)
(QTR-4; AD-280284)

CONTENTS:

1. THEORETICAL AND QUANTUM CHEMISTRY OF N, O, F COMPOUNDS Joyce J. Kaufman p 1–7
2. THE FEASIBILITY OF PREDICTING PROPERTIES OF OXIDIZERS BY QUANTUM CHEMICAL CALCULATIONS Joyce J. Kaufman, Louis A. Burnell, and Jon R. Hamann p 8–35 refs

N65-24885# Joint Publications Research Service, Washington, D. C.
SYNTHESIS OF HEAT-RESISTANT POLYMERS AND STRUCTURE AND PROPERTIES OF ORGANOPHOSPHORUS COMPOUNDS
28 May 1965 123 p refs
(JPRS-30240; TT-65-31076) CFSTI: $4.00

CONTENTS:

1. ADVANCES IN THE SYNTHESIS OF HEAT-RESISTANT POLYMERS V. V. Korshak and Ye. S. Krongauz p 1–78 refs (See N65-24886 14-06)
2. STRUCTURE AND PROPERTIES OF ORGANOPHOSPHORUS COMPOUNDS V. I. Kodolov and S. S. Spasskiy p 79–118 refs

N65-24886 Joint Publications Research Service, Washington, D. C.
ADVANCES IN THE SYNTHESIS OF HEAT-RESISTANT POLYMERS
V. V. Korshak and Ye. S. Krongauz *In its* Syn. of Heat-Resistant Polymers and Struct. and Properties of Organophosphorus Compds. 26 May 1965 p 1–7 8 refs Transl. into ENGLISH from Usp. Khim. (Moscow), v. 33, no. 12, 1964 p 1409–1464 (See N65-24885 14-06) CFSTI: $4.00

Polymeric heat resistance as a function of macromolecular structure, macromolecular chain structure, and macromolecular reactivity; and new heat resistant polymers are discussed. Functions between the structure of the polymeric unit, the macromolecular structure, and the structure of the entire molecule are examined with emphasis on molecular behavior at elevated temperatures. Structural features considered include regularity of chain building, cross-linkings between chains, crystallization capacity, intermolecular forces values, and macromolecular flexibility. Polymeric heat resistance to atmospheric oxygen, water vapor, other chemical reagents, and tendencies toward degradation and structuration are examined. Polymers with heat resistant values above 300° C are investigated and include stereoregular and unsaturated polyhydrocarbons, perfluorohydrocarbons, polyesters, polyamides, carbocyclochain, heterocyclochain, elemento-organic, and inorganic polymers. R.N.A.

N65-24888 Joint Publications Research Service, Washington, D. C.
EFFECT OF SECONDARY ELECTRONS IN RADIOCHEMICAL SYSTEMS
Man-Wei Chang *In its* Transl. on Communist China's Sci. and Technol., No. 182 28 May 1965 p 26–49 refs Transl. into ENGLISH from Hua-hsueh T'ung-pao (Peking), no. 3, Mar. 1965 p 26–35 (See N65-24887 14-04) CFSTI: $3.00

A theoretical and experimental analysis of the effect of secondary electrons in radiochemical systems is presented. Included are data on the production of secondary electrons and their energy chart, the effect of secondary electrons on ionization and excitation, the selected absorption of secondary electrons, and the fate of the subexcitation electrons among secondary electrons. Considered are theories concerning energy transfer; the fate of secondary electrons emphasizing arguments concerning whether they escape the influence of the parent ions to react with the neutral molecules, or are neutralized by the parent ions in the ionization region; electrical conductivity; the concept of aqueous electrons; and reaction velocity. S.C.W.

N65-24897*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FABRICATION OF HIGH-PURITY POLYCRYSTALLINE MgO
Martin H. Leipold and Thomas H. Nielsen 15 May 1965 11 p refs
(Contract NAS7-100)
(NASA-CR-62973; JPL-TR-32-736) CFSTI: HC $1.00/MF $0.50

A technique was developed for the chemical production of very pure magnesium oxide powder. This power is then fabricated by specialized hot-pressing techniques into theoretically dense polycrystalline specimens. Details of the process, including starting reagents, are given. Chemical analysis of the MgO produced by this technique indicates that the material contains approximately one tenth as much impurity as a pure MgO from a commercial source, although the analytical techniques are subject to some question. Initial studies of this pure MgO demonstrate grain growth approximately 100 times that found in MgO of conventionally good purity. Moreover, in the pure material there is no evidence of the reheat porosity at very high temperatures that is found in dense pieces of less pure material. Author

N65-24943 Joint Publications Research Service, Washington, D. C.
DETERMINATION OF FURFUROL IN THE AIR
A. A. Belyakov and V. G. Smirnova *In its* Hyg. and Sanit. in the USSR 26 May 1965 p 44–47 refs (See N65-24938 14-04) CFSTI: $3.00

Methods on color reaction with aniline are investigated for determining furfurol in the air of industrial premises. The reaction results in the formation of dianilide of oxyglutaconic aldehyde, belonging to the class of polymethine dyes. For a more reliable determination of furfurol in air the above reaction is modified using 98%, or icy acetic acid as the absorbent solution and solvent. An aniline concentration within the limits of 50 to 70 mg per ml of acetic acid is preferred. In this case the dyeing of the solutions reached a maximum in 15 minutes and is preserved unchanged for the next 45 minutes. To increase the stability of the dyed solutions, the effect of disubstituted sodium phosphate and oxalic acid was tested. It was found that in the presence of small quantities of Na_2HPO_4 (5 to 15 mg) the dye does not change in the course of an hour; and in the presence of oxalic acid (0.05 to 0.25 mg/ml of acetic acid), there is no change for 2 hours. Photometric determinations of furfurol were made. The proposed methods have been tested and applied in sanitary and hygienic inspection of the working conditions in the production of furfurol. N.E.A.

N65-24944 Joint Publications Research Service, Washington, D. C.
A FAST METHOD FOR DETERMINING LEAD IN THE AIR
V. A. Razumov and T. K. Aydarov *In its* Hyg. and Sanit. in the USSR 26 May 1965 p 48–50 refs (See N65-24938 14-04) CFSTI: $3.00

The following reagents are needed for determining lead in the air: (1) a 0.2% solution of tetrahydroxy-p-benzoquinone in 96% ethanol (best distilled), or, when PbS aerosols are present in the air, a 0.2% solution of reagent in acetic acid with acetone (1:3); (2) a buffer solution of 1.9 g of sodium tartrate and 1.5 g of tartaric acid, soluble in a measuring retort for 100 ml, or a solution of acetic acid with acetone (1:3); and (3) 0.1 mg/ml of a solution of lead salt (standard solution), used to prepare the color scale on paper if it is not possible to create the required concentrations of lead aerosols in a gas chamber. With the reagents a method is described which is fully applicable for quick determinatimon of microcontents of lead in water and other liquids. N.E.A.

N65-24945 Joint Publications Research Service, Washington, D. C.
A CHROMATOGRAPHIC METHOD FOR DETERMINING URANIUM AND PLUTONIUM IN THE AIR
V. F. Pomytkin, A. M. Vorob'yev, G. B. Bokova, and V. I. Fomicheva *In its* Hyg. and Sanit. in the USSR 26 May 1965 p 51–54 refs (See N65-24938 14-04) CFSTI: $3.00

A method, based on the differences in the absorption of trivalent plutonium and sexivalent uranium from a hydrochloric acid solution of anions, is studied for separation of uranium from plutonium in the air. The AMP anion exchange resin gave the best results of the anions tested for absorption of the elements. Samples of aerosols are taken from the air on tissue filters by means of an electric aspirator. After separation procedures the uranium and plutonium content is determined from the alpha activity in a B installation using a scintillation pickup. The quantity of the element (plutonium or uranium) in curies/1 is computed by a formula. The threshold sensitivity of the method with the use of a scintillation attachment was 2×10^{-12} curies in the sample determined. The error of the method does not exceed 20% in measuring small concentrations of uranium and plutonium of the order 10^{-11} to 5×10^{-12} curies in the sample. N.E.A.

N65-24951# Oak Ridge National Lab., Tenn. Isotopes Development Center
RECOVERY OF ^{137}Cs FROM FISSION-PRODUCT WASTES AND TRANSPORT BY AN ALUMINOSILICATE ION EXCHANGER
R. E. Lewis, T. A. Butler, and E. Lamb May 1965 16 p refs
(Contract W-7405-ENG-26)
(ORNL-3765)

A method for recovering fission-product cesium from aged basic fission-product waste with an aluminosilicate ion exchanger (Decalso) was developed and demonstrated. Cesium is selectively adsorbed on Decalso from Hanford Purex Supernatant 103A, a basic 9 M $NaNO_3$ solution, and concentrated by a factor of about 8.5. The Decalso column is transported from HAPO to ORNL in shielded containers formerly used for shipping solutions, and the cesium is eluted with ammonium salts for purification and source fabrication. Author

N65-24955# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
CHROMATOGRAPHIC ANALYSIS OF HELIUM CONTAINING TRACE IMPURITIES
D. W. Shannon Nov. 1964 20 p refs
(Contract AT(45-1)-1830)
(BNWL-12)

A gas chromatograph was developed that has a lower detection limit of below 1 ppm for hydrogen, oxygen, nitrogen, methane, carbon monoxide, and carbon dioxide. The instrument can detect neon, argon, krypton, and zenon; argon and oxygen interfere with each other. This chromatograph uses a tritium source ionization detector. When used with ultrapure helium carrier gas, this device functions as an extremely sensitive helium detector using the metastable helium atoms to increase response at low ppm levels. Construction and operating details are discussed, and a modification is shown that permits total impurity analysis of helium with sensitivities below 1 ppm. Author

N65-24970# Bureau of Mines, Washington, D. C.
SPECTROCHEMICAL ANALYSIS OF TUNGSTEN
R. C. Gabler, Jr. and M. J. Peterson 1965 45 p refs
(BM-RI-6632)

Methods for the direct spectrochemical determination of impurities at the parts-per-million level in tungsten metal and oxide are presented. Several published procedures were investigated, and numerous modifications were made in establishing procedures with improved precision and extended lower levels of determinability. Details of standards preparation are presented, experimental work is described, and three preferred methods are described in detail. A germanium carrier-distillation procedure is applicable to the determination of 13 elements in tungsten powder; a silver chloride carrier-distillation procedure provides for the determination of 24 elements in tungstic oxide, and a sustaining ac arc method is applicable to 26 elements in tungstic oxide. The choice of methods to be used depends upon sample form, elements, and concentrations to be determined, and the precision and accuracy required. Direct spectrochemical methods were developed to determine impurities in high-purity tungsten and tungstic oxide, to define the lower concentration levels of detectability and measurement for the common impurities in tungsten by direct

spectrographic means, and to present the details of the developed or modified methods that have proved applicable.
Author

N65-24972# National Bureau of Standards, Washington, D. C.
RESEARCH ON CRYSTAL GROWTH AND CHARACTERIZATION AT THE NATIONAL BUREAU OF STANDARDS, JULY TO DECEMBER 1964
Howard F. Mc Murdie, ed. 8 May 1965 98 p refs
(NBS-TN-260) GPO: $0.50

A wide program of studies involving crystalline materials is made, including investigation of methods and theory of growth, study of detection and effects of defects, determination of physical properties, refinement of chemical analysis, and determination of stability relations and atomic structure. The types of materials range from organic compounds, through metals, and inorganic salts to refractory oxides. The progress of these various projects is summarized, and the related publications and participating scientists are listed.
Author

N65-25115 Joint Publications Research Service, Washington, D. C.
EXTRACTION OF GERMANIUM
Kungi-i Kuo and Yu-li Ch'en *In its* Trans. on Communist China's Sci. and Technol., No. 179 17 May 1965 p 11-28 Transl. into ENGLISH from Hua-hsueh T'ung-pao (Peking), no. 3, Mar. 1965 p 36-42 (See N65-25114 14-34) CFSTI: $4.00

The extraction of germanium from sulfide ores, coal by-products, and iron ores is discussed. It was concluded that the tannic acid precipitation method is better than the zinc powder replacement precipitation method for refining germanium ore. Also, the smelting conditions of furnace temperature, air pressure, ratio of ingredients, furnace atmosphere, and the speed at which the materials are added to the furnace are important considerations. These factors and the distillation of $GeCl_4$ and hydrolysis are the key to production rate for germanium metallurgy. Further, considerations of automation, continuous production, labor, and safety favor the method of distillation with copper chips over other methods of distillation, extraction, and ion exchange.
E.E.B.

N65-25116 Joint Publications Research Service, Washington, D. C.
APPLICATION OF ORGANIC REAGENTS IN THE POLARIZED TITRATION AND POLAROGRAPHIC ANALYSIS OF INORGANIC SUBSTANCES
P'ei-chih Li *In its* Transl. on Communist China's Sci. and Technol., No. 179 17 May 1965 p 29-44 refs Transl. into ENGLISH from Hua-hsueh T'ung-pao (Peking), no. 3, Mar. 1965 p 42-46 (See N65-25114 14-34) CFSTI: $4.00

The literature on the use of organic reagents for the direct and indirect polarographic determination of inorganic elements and the selection of the reagents best suited for the polarized titration of inorganic elements is reviewed. Also, the electrodes and their electrode potential are tabulated for short-distance polarographic titration. Further, a list of organic reagents useful in polarographic titration and indirect polarographic determination is given, with the specific substances for which these reagents have been found useful.
E.E.B.

N65-25117 Joint Publications Research Service, Washington, D. C.
RING OVEN TECHNIQUE FOR THE ISOLATION AND DETECTION OF THORIUM AND ZIRCONIUM
Shih-nien Shen, Hsin-tu Keng, and Ting-hsueh K'ang *In its* Transl. on Communist China's Sci. and Technol., No. 179 17 May 1965 p 45-49 refs Transl. into ENGLISH from Hua-hsueh T'ung-pao (Peking), no. 3, Mar. 1965 p 59-60 (See N65-25114 14-34) CFSTI: $4.00

A method is described for the precipitation of tetravalent metal positive ions by the ring oven technique using meta-nitrobenzoic acid. Further, with the aid of a supplementary ring of a different diameter the separation of thrioium and zirconium was effected. The thorium and zirconium were then isolated using thorium and zirconium reagents. The following results were achieved: (1) From 0.1 to 500 micrograms of zirconium quantitatively separated from 0.2 to 5 micrograms of thorium; (2) a trace of thorium separated from 700 micrograms of zirconium; (3) 0.1 micrograms of zirconium separated from the spot and 0.2 micrograms separated on the ring; and (4) 0.05 micrograms of thorium isolated by reduction of the width of the filter paper. From 10 to 15 minutes were required for the separation. Also, interference from the various common ions was not observed during the procedures described.
E.E.B.

N65-25119 Joint Publications Research Service, Washington, D. C.
THE STUDY OF THE METHOD OF γ SPECTRUM FOR THE ANALYSIS OF LOW URANIUM-, THORIUM-CONTAINING SUBSTANCES
Hsia Ming, P'u-huo Tsung, and Shu-pen Wu *In its* Transl. on Communist China's Sci. and Technol., No. 179 17 May 1965 p 52-60 Transl. into ENGLISH from K'o-hsueh T'ung-pao (Peking), no. 3, 17 Mar. 1965 p 259-261 (See N65-25114 14-34) CFSTI: $4.00

The use of the high-energy region of the gamma spectrum for the measurement of low uranium and thorium content is discussed. However, it is noted that the low-energy gamma spectrum is still the main region for this measurement. For samples of 500 grams, the effective atomic number of the sample has no significant influence on the third and fourth programs of the low-energy gamma spectrum. Also, the effect of the uranium–thorium ratio (from 1 to 10) can be neglected. Further, for a sample of 500 grams, with uranium and thorium content both greater than 10^{-4}% and with a ratio between 1 and 10, the accuracy can be controlled to within 10% for a measuring time of 60 minutes.
E.E.B.

N65-25138 Lockheed Missiles and Space Co., Palo Alto, Calif. Electronic Sciences Lab.
RELAXATION PROCESSES IN VISCOELASTIC LIQUIDS
G. C. Knollman, A. S. Hamamoto, D. B. Miles, and G. C. Norstrom *In its* Progr. Rept., Jan.–Mar. 1965 [1965] 8 p refs (See N65-25125 14-34)

Shear relaxation characteristics were determined at a number of temperatures for a host liquid, hexachlorobiphenyl, having methanol, toluene, benzene, and acetone in various concentrations as separate impurity liquids. It was found that small amounts of liquid additives in hexachlorobiphenyl lessened the decay rate of cooperative behavior with increasing temperature. This result is associated with relative broadening of the relaxation-time distribution with increasing temperature, due to degraded behavior and an environmental dissimilarity mechanism. Although cooperative behavior phenomena predominated throughout the temperature and concentration range investigated, in the low temperature range the impurity additive primarily decomposed aggregates of cooperative molecules. At higher temperatures the impurity markedly enhanced environmental dissimilarities, and the distribution function widened with increasing (small) concentration of impurity additive.
E.E.B.

N65-25139 Lockheed Missiles and Space Co., Palo Alto, Calif. Electronic Sciences Lab.
RELAXATION SPECTROSCOPY FOR THE LIQUID STATE
G. C. Knollman, A. S. Hamamoto, D. O. Miles, and G. C. Norstrom *In its* Progr. Rept., Jan.–Mar. 1965 [1965] 8 p refs (See N65-25125 14-34)

Experimental determinations were made of the complex, frequency-dependent shear modulus associated with a liquid or polymer system. In this study of liquid–solid mixtures, the liquid used was hexachlorobiphenyl. Aluminum powder of random particle size was added to the liquid to form a suspension. Two samples containing volumes of aluminum particles amounting to 20% and 33.3% of the final suspension volume were used. It was concluded that solid suspensions in viscoelastic liquids can increase the high-frequency asymptote of the energy storage modulus, increase the characteristic relaxation time of the liquid, and shift the peak of the energy-dissipation to lower frequencies. The distribution of relaxation times for the liquid may or may not be affected by the presence of suspended particulate matter, depending on the nature of the suspended solid, the particle size, and the concentration. Further, average relaxation time of the liquid increases markedly with increasing pressure up to the glass transition, and peak energy dissipation is found to occur at lower frequencies, the higher the pressure. E.E.B.

N65-25149# Bureau of Mines, Salt Lake City, Utah. Metallurgy Research Center
REVIEW AND EVALUATION OF SILVER-PRODUCTION TECHNIQUES
C. H. Schack and B. H. Clemmons Mar. 1965 46 p refs
(BM-IC-8266)

Extractive metallurgy techniques currently employed to recover silver from primary ores and secondary scrap were reviewed and evaluated to identify and delineate metallurgical problems whose resolution would increase the supply of silver from domestic materials. The survey revealed that practically all primary silver is recovered by froth flotation concentration of various types of ores, followed by smelting and refining of the separate lead, copper, and zinc concentrates. Silver losses during the complex processing are, with rare exception, inconsequential. Furthermore, any silver production gain from base metal ores, which contribute about two-thirds of the total primary silver, is directly dependent on improvement in the market for the base metals. Statistical data on new and old silver scrap are wholly inadequate to make reliable conclusions about scrap processing problems and the possibility of increasing the recovery of silver from the many forms of secondary silver-bearing materials. The available information indicates (1) that efficient silver reclamation practices are employed by the larger users of silver, and (2) that recovery of additional secondary silver involves solution of problems of collection rather than of processing. Several possibilities exist for limited increases in silver production from primary ores by improvement in metallurgical practices. Specifically, research is needed to (1) solve the problem of recovering silver from the copper ores of the Copper Range district, Michigan; and (2) devise economically feasible methods for recovery of silver from presently marginal or submarginal ores that because of grade, location, and frequently complex nature cannot presently be exploited by conventional techniques. Author

N65-25150# United Kingdom Atomic Energy Authority, Capenhurst (England).
THE PURIFICATION OF SODIUM FROM OXYGEN AND MONITORING OF THE OXYGEN CONTENT IN SODIUM
V. I. Subbotin, P. L. Kirilov, and F. A. Kozlov 1965 17 p refs Transl. into ENGLISH of USSR Rept. 701
(PG-IS-10(R))

Cold and hot traps for sodium purification from oxygen, and monitoring instruments for determining the oxygen content of sodium are described. The main precipitation mechanism of oxides in the cooling, precipitation, and filtration zones of cold traps, and the main properties characterizing the efficiency of several cold trap designs were determined. In the design of hot traps the increase in weight of the zirconium in relation to temperature, the time of exposure to sodium, and the flow rate of the sodium were investigated. Experimental data for both cold and hot traps are tabulated and schematic drawings of trap designs are given. Oxygen content in sodium was determined by distillation and gas distillation methods, plugging indicators, and p-meters. R.N.A.

N65-25151# United Kingdom Atomic Energy Authority, Springfields (England). Chemical and Metallurgical Services
ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF IRON AND NICKEL IN URANIUM TETRAFLUORIDE PRODUCED BY THE FLUIDISED BED PROCESS
1965 8 p
(PG-614(S))

The sample is dissolved in a mixture of nitric and boric acids and aliquots of the resulting solution are taken for iron and nickel determinations. Iron is determined absorptiometrically as the thioglycollate after decomposition of the uranyl thioglycollate with ammonium carbonate. Nickel is determined absorptiometrically as the dimethylglyoxime complex after oxidation with bromine water. Author

N65-25152# United Kingdom Atomic Energy Authority, Springfields (England). Chemical and Metallurgical Services
ANALYTICAL METHOD FOR THE VOLUMETRIC DETERMINATION OF URANIUM TRIFLUORIDE IN THE PRESENCE OF URANIUM TETRAFLUORIDE AND DIOXIDE
1965 8 p
(PG-625(S)) HMSO: 1s 9d

A weighed portion of the sample is dissolved in phosphoric acid containing ferric ion. The ferrous ion resulting from the reduction by U^{III} is titrated potentiometrically with a standard uranyl solution. Author

N65-25153# United Kingdom Atomic Energy Authority, Springfields (England). Chemical and Metallurgical Services
ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF SILICON IN URANIUM COMPOUNDS BY THE TOTAL DISSOLUTION METHOD
1965 7 p
(PG-632(S)) HMSO: 1s 9d

The sample is dissolved in a mixture of nitric and hydrochloric acids and the silicon is solubilized by digestion with hydrofluoric acid. After complexing fluoride with boric acid, the silicon is determined by conversion to silico molybdic acid, which is then reduced to "molybdenum blue" and the absorbancy of the solution measured using a spekker absorptiometer. Author

N65-25159# United Kingdom Atomic Energy Authority, Amersham (England). Health Physics Section
THE ESTIMATION OF THE AMOUNT OF AMERICIUM-241 ON DUST SAMPLING FILTERS. A COMPARISON OF MEASUREMENTS BY ALPHA-COUNTING AND GAMMA-SPECTROMETRY

D. A. Cook Jan. 1965 7 p refs
(RCC-M-177) CFSTI: 1s 9d

Some measurements on a dust sampling filter containing americium^{241} are described. The results given show that when calculating the amount of americium^{241} on glass fiber filter papers from the α-particle absorption may overestimate the activity. Author

N65-25168# United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering Div.
FRESH WATER FROM SEA WATER—A SURVEY OF LARGE SCALE EVAPORATION PROCESSES
I. H. Newson Dec. 1964 25 p refs
(AERE-M-1504) HMSO: 3s 6d

The efficiencies of modern large scale evaporation plants are discussed together with their technical limitations, problems and costs. The most urgent research problems in this field lie in the prevention of scale deposition at temperatures above 250° F and in improving heat transfer and boiling under conditions of small temperature differences. This survey was prepared in December 1963 and is issued without major revision. Author

N65-25170# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
VAPOUR PRESSURES AND HEATS OF EVAPORATION OF WATER FOR SEA-SALT SOLUTION
E. Glueckauf Feb. 1965 7 p refs
(AERE-M-1534) HMSO: 1s 9d

The mean molal empirical osmotic coefficients were calculated from data of the vapor pressures of NaCl solutions at different molal concentrations from 60° to 270° C. These coefficients show less variation for NaCl than real osmotic coefficients, and were therefore used to interpolate the vapor pressure depression caused by the electrolyte content of sea water at various temperatures, and the values for molality or weight-ratio. The sea water composition considered was represented by the following values for mols/1000 g H_2O: MaCl = 0.480; $MgCl_2$ = 0.035; $MgSO_4$ = 0.018; and $CaSO_4$ = 0.010. The excess heat of evaporation and subsequently the total heat of evaporatidn were then evaluated from the true osmotic coefficients of NaCl, and show that the salt content makes a small positive contribution to the heat of evaporation. At room temperature this effect is negative. G.G.

N65-25172# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE EXTRACTION OF NITROSYLRUTHENIUM NITRATO COMPLEXES FROM NITRIC ACID SOLUTION BY TRI-SUTYLPHOSPHATE
B. F. Greenfield and C. J. Hardy Dec. 1964 13 p refs
(AERE-R-3868) HMSO: 2s 6d

The distribution coefficient (D_{Ru}) of nitrato complexes of nitrosylruthenium between 100% TBP and nitric acid was studied as a function of the nitric acid concentration (0.1 to 14 M), the equilibration time, and the temperature (0° to 70° C). For several conditions it has a maximum at about 1 M HNO_3 and a minimum at about 12 M HNO_3. Its temperature coefficient is positive for 12 M HNO_3 and zero for 8 M HNO_3; for 1 M HNO_3, it is negative below, and positive above 20° C. Author

N65-25174# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE EFFECTS OF WATER VAPOUR, CARBON MONOXIDE AND PORE VOLUME ON THE RADIOLYTIC REACTION BETWEEN CARBON DIOXIDE AND GRAPHITE IN SEALED TUBES
F. S. Feates Dec. 1964 34 p refs
(AERE-R-4332) HMSO: 5s

Irradiations were conducted in sealed tubes at gas pressures up to 25 atmospheres and at a temperature of 180° C to test the influence of water vapor on the radiolytic gasification of graphite in a CO_2 or CO/CO_2 atmosphere. Within the limits of experimental error (±10%) no effect of water vapor at concentrations up to 1.7 vol% has been detected for a reactor radiation dose of about 100 eV/molecule gas. A large effect of pore volume of graphite powders on G(CO) and G(−C) was observed at pressures up to 25 atmospheres. The effectiveness of dry carbon monoxide in protecting graphite from subsequent gasification in carbon monoxide–carbon dioxide mixtures was also investigated in sealed tube experiments. No evidence for protection was found. Author

N65-25176# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE RADIOLYTIC REACTION BETWEEN GRAPHITE AND CARBON DIOXIDE. GAS FLOW EXPERIMENTS, PART II: EFFECTS OF PRESSURE, TEMPERATURE AND GAS FLOW RATE
F. S. Feates and F. A. Walker Dec. 1964 52 p refs
(AERE-R-4659) HMSO: 7s

Experiments in which gas flow rates are varied are used to estimate apparatus constants for the equipment employed. Methods are shown for the determination of initial values of G(CO) and G(−C). The G(−C) is slightly pressure sensitive, passing through a maximum value at about 10 atmospheres pressure. It is also sensitive to temperatures above 300° C, rising by a factor of 2 as the temperature is raised from 300° to 500° C. The heterogeneous steps in the gasification of graphite by irradiated carbon dioxide are considered, and a mechanism involving the participation of radiolytically generated surface oxides is proposed. An oxidizing agent, tentatively identified as ozone, is evolved from a stainless steel in-reactor apparatus. Neon-23 was detected as a radioactive impurity in the effluent from the apparatus. Author

N65-25180# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE DETERMINATION OF NITROGEN IN URANIUM NITRIDES—PART II
G. W. C. Milner, G. Jones, D. Crossley, and G. Phillips Sep. 1964 18 p refs
(AERE-R-4713) HMSO: 3s

Application of the Kjeldahl method to the analysis of uranium nitrides in the range of compositions from UN to $UN_{1.7}$ was investigated. Uranium mononitrides are soluble in hydrochloric acid containing hydrofluoric acid, and the Kjeldahl method is applicable to such solutions. A coefficient of variation of 0.5% was obtained for the determination of the nitrogen contents of mononitrides, and results agree with those produced by the Dumas method. The higher nitrides ($UN_{1.5}$ to $UN_{1.7}$) proved to be more resistant to solution in mineral acids, and the best solution procedures so far have resulted in some losses of nitrogen taking place. For this type of sample a negative bias of a few percent has been obtained for the determination of the nitrogen content. Author

N65-25182# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE DETERMINATION OF ACTINIUM-227 IN EFFLUENT
B. A. Loveridge, M. S. Gordon, and J. R. Weaver Dec. 1964 25 p refs
(AERE-R-4747) HMSO: 3s 6d

Actinium is recovered from a 1-liter aliquot of effluent by coprecipitation with ferric hydroxide. If algae are present, the precipitate is dissolved in acid and oxidized with nitric

and perchloric acids before adjusting the acidity to pH 1.6 and extracting the actinium with di-(2-ethylhexyl)orthophosphoric acid in heptane. The actinium is back extracted into 1.5 N hydrochloric acid and the solution is passed down an anion exchange column to remove traces of lead, bismuth, and polonium. The eluate containing the actinium is evaporated. Following an overnight delay to permit the major part of any actinium 228 to decay, the residue is dissolved in dilute acid and fed to a reverse phase partition chromatography column (di-(2-ethylhexyl)orthophosphoric acid in toluene supported on poly(-vinyl chloride/vinyl acetate) copolymer) to separate actinium from the rare earths and from its own daughters which have grown in again overnight. The eluate is evaporated and the residue taken up in dilute acid to be mixed with a liquid scintillator for beta counting. Radiochemical recoveries range from 80% to 95%, and decontamination factors from other nuclides are equal to or greater than 1×10^5 for those tested. Author

N65-25183# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
BIBLIOGRAPHY OF UNCLASSIFIED REPORT AND PUBLISHED LITERATURE ON THE TRANSPLUTONIUM ELEMENTS (1957–1964)
R. W. Clarke, comp. Oct. 1964 98 p refs
(AERE-R-4761) HMSO: 13s

N65-25185# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
BIBLIOGRAPHY OF UNCLASSIFIED REPORTS AND PUBLISHED LITERATURE ON NEPTUNIUM (1957–1964)
R. W. Clarke, comp. Nov. 1964 56 p refs
(AERE-R-4792) HMSO: 8s

N65-25186# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE RADIOLYTIC REACTION BETWEEN GRAPHITE AND CARBON DIOXIDE. GAS FLOW EXPERIMENTS, PART III: SURFACE COMPLEXES AND TRANSIENT EFFECTS
F. S. Feates and J. R. Parry Dec. 1964 30 p refs
(AERE-R-4819) HMSO: 4s 6d

Improved equipment is described for studying the reaction between radiolyzed carbon dioxide and graphite in BEPO. The formation on the graphite of surface complexes which can be decomposed thermally and which play an important part in the gasification reaction was confirmed. The effect of methane on the gasification rate is unexpectedly small, and this is believed to be associated with the absence of ozone from the effluent gas from this equipment when experiments are conducted in pure CO_2. Transient behavior on changing apparatus parameters are interpreted in terms of surface adsorption processes. Author

N65-25187# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
A REVIEW OF THE KINETICS AND MECHANISMS OF OXIDATION AND HYDRIDING OF ZIRCONIUM ZIRCALOY-2, AND Zr-2 1/2% Nb ALLOY
J. K. Dawson Dec. 1964 50 p refs
(AERE-R-4820) HMSO: 7s

Evidence on the kinetics and mechanisms of the oxidation and hydriding of zirconium and two of its technologically important alloys at temperatures below 400° C is reviewed. For reaction with oxygen, four distinct regions of the oxidation curves are defined. The control of the oxidation may differ in each of these regions, proceeding from an initial interface reaction through two stages of control by lattice diffusion of anions in the growing oxide film, to leakage path diffusion, and finally to a complex equilibrium situation in the posttransition region. Some of the evidence indicates that the nature of the oxidation may not be the same in steam or water as in oxygen, and that wide generalizations may not be possible. The effects of reactor radiations on the corrosion processes are described, and their causes are discussed. Suggestions are made for further investigations. Author

N65-25188# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE EFFECTS OF CARBON STRUCTURE ON THE RATE OF OXIDATION OF C-14 LABELLED CARBONS BY IRRADIATED CARBON DIOXIDE
F. S. Feates and A. G. Poole Jan. 1965 15 p refs
(AERE-R-4828) HMSO: 2s 6d

A wide variety of C-14 labeled carbons (varying from a high surface area carbon black to pyrographite) were irradiated with carbon dioxide in sealed silica tubes in nuclear reactors. Attempts were made to eliminate effects of surface condition on the rate of oxidation, and experiments were conducted at gas pressures of 1 and 30 atmospheres, and at temperatures of 120° and 250° C. Within a scatter band of about a factor of 2 there is little difference in the rate of C-14 gasification or carbon monoxide production from any of the carbons, other than a carbon black, which appears to gasify at a consistently higher rate. This is contrasted to the large differences of gasification rate obtained for the corresponding thermal reaction. Author

N65-25189# United Kingdom Atomic Energy Authority, Wantage (England). Isotope Research Div.
IRRADIATION OF CARBON DIOXIDE CONTAINING SMALL AMOUNTS OF METHANE
R. W. Hummel Jan. 1965 34 p refs
(AERE-R-4838) HMSO: 5s

Carbon dioxide containing from 500 to 13 000 Vpm of methane was irradiated with 4 MeV electrons and ^{60}Co gamma rays. Methane consumption, and formation of H_2, H_2O, and C_2H_6 were studied in closed bulb experiments. Some results were also obtained in a circulating-flow system at constant CH_4 concentration. Temperatures were varied from 17° to 500° C; pressures were mainly near atmospheric. The G values are reported, and possible reactions are discussed. Author

N65-25190# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE EFFECT OF HYDROGEN AND WATER ON THE RADIATION INDUCED REACTION OF CARBON DIOXIDE WITH GRAPHITE
H. B. F. Gow and W. R. Marsh Jan. 1965 35 p refs
(AERE-R-4839) HMSO: 5s

The radiation-induced reaction of carbon dioxide with graphite was studied in the presence of added hydrogen and water at temperatures between 100° and 600° C. At 600° C hydrogen reacts rapidly and an equimolar amount of carbon monoxide is formed, the only other product of the reaction being water. The reaction is temperature dependent having an apparent "activation energy" of 21 kcal/g mole. The subsequent rate of production of carbon monoxide after complete reaction of hydrogen is the same as that from pure carbon dioxide. At 100° C, the reaction rate is slower but still much greater than that due to thermal processes which are negligible at this temperature. The effect of added water is also temperature dependent. Above 350° C there is little effect of the addition of water on the production of carbon monoxide, but at 100° C a much lower rate of carbon monoxide production is observed, and, in addition, hydrogen is formed. Author

N65-25202# American Cyanamid Co., Bound Brook, N. J. Organic Chemicals Div.
STUDY OF CHROMOTROPIC PROPERTIES OF COLORANTS Technical Report, Oct. 29, 1962–Jan. 28, 1964
Walter H. Foster, Jr., Haig C. Donoian, and Marion Mason Natick, Mass., Army Natick Labs., Feb. 1964 80 p refs
(Contract DA-19-129-AMC-19(X))
(TS-129; AD-449505)

To explore feasibility of using chromotropic colorants for a chameleon-type camouflage system, photochromic, thermochromic, and chemochromic systems were studied. Where possible, simple theoretical models for the various systems were analyzed mathematically to establish the thermodynamic and kinetic quantities which a suitable system must possess. Known compounds, representative of the three chromotropic classifications, were examined experimentally in both solution and polymer media. Consideration of the theoretical analyses and experimental results indicates that photochromic systems presently offer the most feasible approach for a chromotropic camouflage system. Of the presently available photochromic systems examined, the system based upon dithizone and its metal complexes—particularly Hg(II)—showed the most promising results. The dithizonate system should provide a useful model system for future synthetic and physical chemical work in this area. Author

N65-25206# Rice Univ., Houston, Tex. Dept. of Chemistry
OPTICAL SPECTRA AND MOLECULAR PARAMETERS OF LIGHT ELEMENT MOLECULES Progress Report, 1 Jan.–31 Mar. 1965
John L. Margrave [1965] 5 p refs
(Contract DA-31-124-ARO(D)-91; ARPA Order 40)
(PR-8; AD-462846)

Research progress is reported on vacuum ultraviolet spectroscopy, visible and ultraviolet spectroscopy, infrared spectroscopy, and thermodynamic properties of light element molecules. Absorption by N_2F_4 at various pressures in the range 0.1 to 1 torr was investigated in the Xe continuum region at temperatures between 25° to 100° C. No band structure other than that due to NO was observed. The temperature effected a decrease in the incident beam attenuation by N_2F_4. Absorption by OF_2 and PF_3 in the Xe continuum region showed continuum absorption by these compounds but no indication of band structure. Spectra from a N_2–Cl_2 mixture excited in a radiofrequency plasma torch gave no significant results. A blue luminescence was observed in high temperature studies of the $SiF_4 + Si + O_2$ system. An infrared absorption spectra was observed at 715 and 730 cm^{-1} bands in a cell connected to an ac discharge through CH_4. The latter band weakens after a short period and is due to C_2H_2 formed in the discharge, while the first band increases in intensity and is possibly due to a charged free radical. Mass spectrometric investigations were undertaken on gaseous CrF_2 and CrF, FeF_2, and gaseous TiF. R.N.A.

N65-25207# Naval Ordnance Lab., White Oak, Md.
DISSOCIATION OF POLYNITROMETHYLCARBINOLS. III: RATES OF EQUILIBRATION OF 2,2-DINITROPROPANOL IN WATER
Thomas N. Hall Oct. 1964 21 p refs
(NOLTR-64-104; AD-448068)

The rates of equilibration of 2,2-dinitropropanol in aqueous $HPO_4^{=} - H_2PO_4^{-}$ buffers have been measured at 25.13° and 9.64°. Rhese have been shown to be consistent with the following equilibration mechanism:

$$CH_3C(NO_2)_2CH_2OH + X \overset{\text{fast}}{\rightleftarrows} CH_3C(NO_2)_2CH_2O^- + XH^+$$

$$CH_3C(NO_2)_2CH_2O^- + H_2O \overset{\text{slow}}{\rightleftarrows} CH_3C(NO_2)_2^- + CH_2(OH)_2,$$

where X is a general base. Author

N65-25218# Douglas Aircraft Co., Inc., Santa Monica, Calif. Astropower Lab.
SOLUTION AND CONDUCTIVITY STUDIES OF FLUORINE-CONTAINING OXIDIZERS Quarterly Progress Report, 15 Dec. 1964–15 Mar. 1965
M. S. Toy, W. A. Cannon, and W. D. English Apr. 1965 69 p refs
(Contract DA-31-124-ARO(D)-115; ARPA Order 470)
(Rept.-144-Q7; AD-462086)

This report summarizes results of solution and conductivity studies of fluorine-containing oxidizers. Specific conductivities of mixtures of halogen fluorides and of potential electrolytic solutes are measured and interpreted. Possible mechanisms are discussed. Tests of selecting electrode materials for halogen fluorides were initiated. A solution that is an excellent conductor at low temperature was developed. A specific conductivity of 7.6×10^{-3} $ohm^{-1}cm^{-1}$ at −60° C was measured in a tertiary BF_3–BrF_3–ClF_3 system. Another accomplishment is the identification of solid from reaction of BF_3 and BrF_3 as difluorobrominium tetrafluoroborate ($BrF_2^+BF_4^-$). It is a new thermally stable solid oxidizer (m.p. 180° C dec.) The previously obtained solid from the reaction of tetrafluorohydrazine with arsenic pentafluoride is crystalline (hexagonal, a = 9.06 Å and c = 14.3 Å) and sublimes at 350° C with decomposition. Its structure elucidation is continuing. Author

N65-25224# Aberdeen Proving Ground, Md. Ballistic Research Labs.
SEDIMENTATION OF CHEMICALLY REACTING MACROMOLECULES. PART I: THEORY
R. C. Makind and E. Rogers Aug. 1964 33 p refs
(BRL-1252; AD-448449)

A mathematical analysis is made of two chemically interacting macromolecules sedimenting in a liquid solvent under one-dimensional electric and cylindrical centrifugal forces that are sufficiently large to dominate over diffusive forces. The singularities and jump conditions across discontinuity lines are derived and discussed in terms of physical observations. Author

N65-25228# College of Advanced Technology, Birmingham (England).
ELECTRON AFFINITIES OF INORGANIC RADICALS Final Technical Report, 1 Feb. 1963–31 Jan. 1964
F. M. Page [1964] 12 p
(Contract DA-91-591-EUC-6-2808)
(AD-434912)

Electron affinities and bond dissociation energy of inorganic radicals were determined. It was found that tetracyanoethylene was a remarkedly good electron acceptor whose electron affinity was 151 ±2 kcal at 0° K. In addition to its properties as an electron sink the compound showed a very high heat of desorption of 124 kcals. Such a high heat of desorption is shown by oxygen, but the work function is increased and the electron emission is reduced. Tetracyanoethylene has the opposite effect; its dipole field reduces the work function of the filament and the electron current is increased. Also, the electron affinity of SF_6 was found to be 34.3 ±2 kcals corrected to 0° K. The electron affinity of SF_5 was 84.4 ±1 kcal; the bond dissociation energy of SF_5–F was 86.1 ±3 kcal; and the bond dissociation energy for SF_4–F was 35.1 ±1 kcals. Further, the electron affinity of NO_2 was 92 ±3.7 kcal, and an electron affinity of 20.6 ±2.5 kcal was measured for NO. E.E.B.

N65-25243# Dow Chemical Co., Denver, Colo. Rocky Flats Div.
PLUTONIUM OXIDE SHIPPING PACKAGES
F. E. Adcock, J. J. Byrne, and R. L. Delnay 28 Apr. 1965 89 p refs
(Contract AT(29-1)-1106)
(RFP-501) CFSTI: $1.00

The design, testing, and evaluation of containers for the shipment of plutonium oxide are described. The description, design criteria, loading and unloading procedures, and test results for the pressure vessel and its inner container, and two classes of outer containers are discussed. A hydrostatic pressure test on the pressure vessel resulted in failure at 1200 psi. The containers were tested for impact, penetration, water spray and compression under normal conditions of transport. They were also tested for impact, puncture, fire, and water immersion under accident conditions. Both containers qualified as suitable shipment vessels. R.N.A.

N65-25253# Mound Lab., Miamisburg, Ohio.
LOW-LEVEL INTERNAL GAS PHASE PROPORTIONAL COUNTING OF KRYPTON-85 IN XENON
K. F. Wylie, G. R. Hagee, and R. W. Ostensen 4 Jun. 1965 13 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1247) CFSTI: $1.00

Methods for routine measurement of trace amounts of krypton-85 in xenon were investigated to extend limits of detection below 10^{-12} at.%. Internal gas phase counters were used because of their high efficiency. Background counting rate was minimized by lead shielding and an anticoincidence ring. Proportional counting gas mixture, found to give an acceptable counting plateau, was 50% methane and 50% xenon. Standard krypton-in-xenon samples were prepared and used to calibrate the 1-liter proportional counting chambers. In spite of high background counts, the method was successful; standard samples of 2.18×10^{-13}, 3.17×10^{-10}, and 6.43×10^{-9} at.% krypton-85 in xenon were determined within the 0.95 error of the counting rate on the plateau. Author

N65-25293# Dow Chemical Co., Denver, Colo. Rocky Flats Div.
COMPATABILITY STUDIES OF ANION EXCHANGE RESINS. PART 1: THE COMPATIBILITY OF DOWEX 1×4 NITRATE FORM ANION RESIN WITH NITRIC ACID AND OXIDES OF NITROGEN
G. F. Molen 17 May 1965 20 p refs
(Contract AT(29-1)-1106)
(RFP-531) CFSTI: $1.00

The compatibility of Dowex 1×4 nitrate form anion exchange resin with nitric acid, and the compatibility of several types of plastic tubing with nitric acid were investigated. Ignition properties of resin extract, treated resin and mixtures of tubing extract with either resin extract or treated resin were also investigated. Author

N65-25299# American Meteorological Society, Boston, Mass.
INFLUENCE OF THE GEOMETRICAL PARAMETERS OF CATALYST STRUCTURE ON REACTION RATES [INFLUENCE DES PARAMETRES GEOMETRIQUES DE LA TEXTURE DES CATALYSEURS SUR LA VITESSE DES REACTIONS]
Pierre Le Goff Bedford Mass., AFCRL, Mar. 1965 32 p refs Transl. into English from J. Chem. Phys. (France), v. 51, 1954 p 729–739
(Contract AF 19(604)-6113)
(T-F-49; AD-461225)

The apparent rate of a heterogeneous chemical reaction in an isolated pore assumed to be cylindrical with a circular cross section is studied, particularly for long reactors with unspecified reactive surface and inlet and outlet openings that may coincide. The reaction is assumed to be a first order kinetic reaction and the pore size such that the flow of the gas is a Knudsen flow. First, it was assumed that the entire surface of the pore wall is reactive; and second with two particular reactors that only a fraction of the surface is reactive. These theories were applied to actual catalysts and were extended to the domain of the highest pressures. The mathematical solution suggested makes it possible to define the familiar phenomenon of the existence of two operating states of the pore, called slow and rapid. The apparent activation energy is reduced by half in passing from the first to the second state. The effect of the poisoning of the reactive surface on these two states was investigated and the theory applied to actual catalysts having a regular structure. Comparison of the calculations with experimental results shows good agreement. R.W.H.

N65-25310# Atomic Energy of Canada, Ltd., Ottawa (Ontario). Commercial Products Div.
CONTAMINATION CONTROL AND WASTE DISPOSAL IN HIGH LEVEL ISOTOPE OPERATIONS AT AECL
A. F. Trott Apr. 1965 18 p Presented at the ENEA Intern. Symp. on Working Methods in High Activity Hot Labs., Grenoble, France, Jun. 1965 *Its* Paper No. 36
(AECL-2233) Available from Atomic Energy of Canada, Chalk River: $0.50

Ten years of operating experience handling multikilocurie quantities of Co^{60} and other isotopes in a plant near the center of a city and remote from radioactive waste disposal facilities is reviewed. Contamination control, including ventilation design, continuous effluent air monitoring, and filtration; continuous effluent water monitoring; incell monitoring; liquid and dry waste processing and removal from hot cells; and removal, packaging, and transportation of waste from the plant site to burial are described. Author

N65-25324# Franklin Inst., Philadelphia, Pa. Chemistry Div.
DIFFUSION IN ORGANIC CRYSTALS Quarterly Technical Report, 1 Jan.–31 Mar. 1965
P. J. Reucroft, C. H. Lee, H. K. Kevorkian, and P. Chairge [1965] 14 p ref
(Contract DA-31-124-ARO(D)-142; ARPA Order 462)
(B2130-T-7; AROD-4168-5; AD-461559)

Studies on the diffusion of phenanthrene-9-C-14 perpendicular to the ab and ac planes of anthracene crystals have shown that while the diffusion of this molecule perpendicular to the ac plane is similar to self-diffusion, the diffusion process perpendicular to the ab plane differs from the self-diffusion

process. Although the level of the concentration profile is lower than that obtained for diffusion perpendicular to the ac plane, diffusion coefficients are higher and characterized by a lower activation energy. This means either the main bulk diffusion process is not taking place and only the secondary "fast" process is being observed or that the effective surface concentration of diffusant is reduced on the ab surface. In either case it appears that impurity diffusion is more anisotropic than self-diffusion. Segregation coefficients have been determined for phenanthrene impurities in pyrene by means of directional freezing experiments. Segregation behavior is found to be very similar to that observed for anthracene impurities in pyrene. Anomalies have been found on comparing the segregation coefficient of 1,2-benzanthracene in pyrene with the main features of the benzanthracene-pyrene solid–liquid phase diagram. Phase equilibrium studies at the concentration level of benzanthracene in pyrene where the directional freezing studies were carried out may, however, resolve these discrepancies. Author

N65-25325# Rice Univ., Houston, Tex. Dept. of Chemistry
RESEARCH IN FLUORINE CHEMISTRY Progress Report, 1 Jan.–31 Mar. 1965
John L. Margrave [1965] 9 p
(Contract DA-31-124-ARO(D)-110)
(PR-7; AD-462838)

Research progress is reported on vapor pressures of fluorides, high temperature heat contents and entropies of fluorides, and new fluoride compound synthesis. Mass spectrometric studies were completed on $CrF_2(g)$ and CrF(g), and were employed in measuring the sublimation rate of FeF_2 and the stability of TiF(g). The assembly for heating a calorimetric sample by induction was completed. Studies on the polymerization of silicon difluoride in inert gas matrices, and the reaction of silicon difluoride with aromatic compounds and oxygen were continued. A vacuum system for gas reactions with silicon difluoride was completed and tested. Kinetic studies of the fluorination of hot pressed TiC are progressing. Pyrophyllite has been machined into holding rings for holding samples and calibrating pressures. A bibliography is included. R.N.A.

N65-25342# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
REMOVAL OF TRIBUTYL PHOSPHATE AND ITS DEGRADATION PRODUCTS FROM ACIDIFIED URANYL NITRATE SOLUTIONS
H. T. Hahn, E. M. Vander Wall, R. H. Ray, and R. G. Butzman Aug. 1964 34 p refs
(Contract AT(10-1)-205)
(IDO-14630) CFSTI: $0.75

Behavior of tributyl phosphate and its degradation product, dibutyl phosphate, in plant streams during solvent extraction reprocessing of enriched uranium was studied by analysis of plant samples. Distribution and kinetic data for extraction of unwanted tributyl phosphate from aqueous process streams were obtained for the design of a solvent extraction contactor for this purpose. Laboratory and pilot plant data demonstrated effective removal of undesirable dibutyl phosphate from aqueous process streams by sorption on hydrous zirconium oxide. Zirconium oxide can be regenerated with sodium hydroxide and used for many cycles. It can be dissolved in warm 8-molar nitric acid for final disposal. Author

N65-25374*# Gulton Industries, Inc., Metuchen, N. J. Alkaline Battery Div.
INVESTIGATION OF BATTERY ACTIVE NICKEL OXIDES Third Quarterly Report, 13 Dec. 1964–13 Mar. 1965
P. Ritterman. [1965] 67 p refs
(Contract NAS3-4178)
(NASA-CR-54402) CFSTI: HC $3.00/MF $0.75

Study of the effect of stand, at various temperatures, on the tubular graphitic nickel oxide electrode was concluded. Investigation into the effect of overcharge on the composition of the sintered nickel oxide electrode continued. The positive electrode of a two-plate cell was continually monitored by X-ray equipment during charge, overcharge and stand. Diffraction patterns were taken between the angles of $2\theta = 12°$ to 14.5°. The growth during charge and overcharge, and the decline on stand, of a peak between these two angles were noted. In a separate experiment, it was shown that no strange lines occurred because of crystallization of KOH during overcharge. Study of the effect of state of charge on the composition of sintered plate nickel oxide electrodes continued. The study was made by X-ray diffraction patterns obtained from positive electrodes charged and discharged to various degrees at the C and C/10 rates. Analysis of positive electrodes at various states of charge, by differential thermal analysis and chemical analysis was started. Positive electrodes discharged to the graphitic level were also analyzed by means of X-ray and D.T.A. Author

N65-25416# New York Univ., N. Y. Dept. of Aeronautics and Astronautics
LAMINAR BOUNDARY LAYERS WITH CHEMICAL REACTIONS. PART I: ANALYSIS Interim Report
Herbert Fox Feb. 1965 25 p refs
(Contract DA-31-124-ARO-D-259; Grant AF-AFOSR-62-409)
(NYU-AA-65-3; AROD-5020-1; AD-462698)

A discussion is presented of the chemically reacting laminar layer; the problem of simultaneous gas phase and wall reaction is considered. The basic solutions, under conditions of unit transport properties, i.e., mass density-viscosity product constant, Prandtl number and Schmidt unity, are derived using previously devised operator techniques. For gas phase reaction the solution for the species distribution is seen to reduce to an integral equation; the temperature arising by quadrature. It is shown that simple first-order results for chemistry of the usual complexity occurring in the hypersonic boundary-layer flow can be obtained without resort to large-scale computation. The flows over a catalytic wall are derived from unit solutions to the basic problem. Thus the combined problems of finite rate chemistry and finite catalysis are considered. Author

N65-25419# Stanford Research Inst., Menlo Park, Calif.
DIFFUSION AND HETEROGENEOUS REACTION. VII: EFFECT OF DIFFERENT CATALYST GEOMETRIES
C. M. Ablow, H. Motz, and H. Wise Mar. 1965 23 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(SRI-20-P; AD-461809)

Diffusion kinetics of a system undergoing heterogeneous catalytic reaction are examined theoretically by solving a diffusion equation which takes into account both radial and longitudinal diffusion due to the presence of catalytic surfaces. Two cases considered are an infinite cylinder composed of sections with different catalytic activities, and a finite cylinder with a catalytic end plate of fractional area. It is shown that the atom density at a point in the diffusion tube is strongly influenced by the upstream activity of the cylinder walls for atom recombination. Experimental studies involving cylindrical inserts of known length but unknown activity, located in a glass cylinder for which the recombination coefficient was established previously, are shown to enable determination of the catalytic activity of the initial section by making a single atom

density measurement downstream of the insert. Alternatively, the catalytic activity of the insert can be determined by evaluation of the atom densities at the end of the insert for inserts of various lengths. Theoretical results for oxygen atom recombination on the surface of various metallic oxides agree with experimental data. For the case of a fractional catalyst end plate area of 25%, results indicate a reduction of the effective catalytic activity by a factor of 4. Author

N65-25427# Joint Publications Research Service, Washington, D. C.
ATRANES: NEW METHOD FOR SYNTHESIS OF 1-ALKYL- AND ARYLSILATRANES
M. G. Voronkov and G. I. Zelcans 8 Jun. 1965 11 p refs Transl. into ENGLISH from Khim. Geterotsikl. Soyedineniy (Riga), no. 1, 1965 p 51–57
(JPRS-30491; TT-65-31202) CFSTI: $1.00

Discussed is the synthesis of 1-organylsilitranes based on the splitting of polyorganylsesquisiloxanes $(RSiO_{1.5})_x$ or polyorganylsiloxanols $[RSiO_{1.5-y}(OH)_{2y}]_x$ with triethanolamine in the presence of catalytic amounts of an alkaline metal hydroxide according to the system:

$$1/x[RSiO_{1.5-y}(OH)_{2y}]_x + (HOCH_2CH_2)_3N \rightarrow RSi(OCH_2CH_2)_3N + (1.5 + y)H_2O,$$

as well as synthesis from polyorganylhydrosiloxans of the type $(RSiHO)_m$ according to the system:

$$1/m(RSiHO)_m + N(CH_2CH_2OH)_3 \rightarrow RSi(OCH_2CH_2)_3N + H_2O + H_2.$$

The yields of the six 1-organylsilitranes obtained by both methods, their melting points, solubility in water, analytical data, and determination of the molecular weight are shown in a table. G.G.

N65-25446# Texaco Experiment, Inc., Richmond, Va.
PARA-ORTHO HYDROGEN CONVERSION Quarterly Progress Report No. 5, Jun.–Aug. 1964
Gordon H. Miller and Lloyd J. Parcell 15 Sep. 1964 20 p
(Contract AF 33(657)-11123)
(TM-1581; EXP-430; AD-461007)

Rates of hydrogen permeation through rhodium-plated iron and palladium-plated carbon steel are given as a function of temperature. Palladium deposits on various nonmetallic substrates are being examined for their effectiveness in hydrogen conversion; the best material appears to be palladium on polyethylene. The effect of an applied electric field on the permeation rate of hydrogen through palladium–silver alloy was negative. The mechanism for hydrogen conversion at precious-metal surfaces shifts from the combined dissociative and paramagnetic mechanism at room temperature to substantially only a paramagnetic one at liquid-nitrogen temperature. Author

N65-25473# Los Alamos Scientific Lab., N. Mex.
HEATS OF DISSOCIATION OF GASEOUS HALIDES
R. C. Feber Nov. 1964 189 p refs
(Contract W-7405-ENG-36)
(LA-3164) CFSTI: $5.00

Heats of dissociation at 298.15° K of the gaseous fluorides, bromides, and iodides of elements of the first long period of the periodic table and beyond are calculated from available experimental data for the heats of formation of the condensed phases and data for vapor pressure and other equilibria. Results derived previously for the chlorides are included and in some cases modified or extended with subsequent data. Estimates are made for many of the halides for which experimental data are lacking. The previous review of heats of atomization of selected elements is extended to include several more elements and more recent vapor pressure data for the remaining elements. Author

N65-25476# United Kingdom Atomic Energy Authority, Springfields (England). Chemical and Metallurgical Services
ANALYTICAL METHOD FOR THE SPECTROGRAPHIC DETERMINATION OF THORIUM IN MAGNOX ZR55 AND MAGZAN ALLOY
1965 18 p
(PG-615(S)) HMSO: 3s

The sample is dissolved in hydrochloric acid in the presence of a small amount of fluoride. Thorium and zirconium are separated from the magnesium by precipitation with ammonia, and the zirconium is then separated from thorium by extraction into chloroform as the cupferrate. Finally the thorium is coprecipitated on ferric hydroxide and is determined spectrographically by the iron flux method using a Jarrell–Ash grating instrument. Author

N65-25477# United Kingdom Atomic Energy Authority, Springfields (England). Chemical and Metallurgical Services
ANALYTICAL METHOD FOR THE FLAME-PHOTOMETRIC DETERMINATION OF SODIUM AND POTASSIUM IN ALUMINA
1965 10 p
(PG-628(S))

The sample is dissolved in phosphoric acid and the solution analyzed for sodium and potassium, using an EEL flame photometer. The method, as written, is suitable for the determination of 0.1% to 2.0% sodium and 0.2% to 2.0% potassium in alumina which can be in the form of either powder or sintered pellets. The precision has not been measured but the maximum error is estimated as ±15% (relative) at the 0.5% sodium or potassium level. Author

N65-25493# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE PREPARATION OF 1, 2 DI-n-BUTOXY ETHANE (DIBUTYL CELLOSOLVE)
A. Pilbeam Dec. 1964 16 p refs
(AERE-M-1387)HMSO: 2s 6d

The development of the preparation on the liter scale of 1, 2 di-n-butoxy ethane (dibutyl cellosolve, DBC) based on the Williamson synthesis is described. The product is of suitable purity for use as a diluent in liquid/liquid extraction experiments related to the reprocessing of nuclear fuels. The analytical control of the specification of product by gas chromatography is described. Distribution of DBC in systems with mono-n-butyl cellosolve (MBC) and water (or dilute nitric acid) was measured and the solubility of purified DBC in water or dilute nitric acid obtained by infrared spectrometry. Author

N65-25500# United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering Div.
PROCESSING IN LIMITED GEOMETRY. PART XII: GAS-SOLID REACTIONS IN STIRRED BEDS. I: THE HYDROGEN REDUCTION OF URANIUM TRIOXIDE
R. F. Taylor and F. R. Dell Mar. 1965 35 p refs
(AERE-R-4768)

Fluid-bed UO_3 was reduced on a continuous basis with hydrogen in a 2-in. diameter screw-flight stirred bed reactor at rates of up to 3 kg/h. Conversion efficiencies and production rates were analyzed in terms of solids residence times and the isokinetic equivalent of the temperature profile along the reaction bed. Experimentally obtained activation energy of 29 ±2 kcal/mole, and the overall rates of reaction for the

process agree with values established by thermobalance studies. By using activated feeds, conversions were carried out in 12 minutes at 530° C, and UO_2 was produced which can be sintered to 97% theoretical density. Author

N65-25505# United Kingdom Atomic Energy Authority, Harwell (England). Library
STUDY ON THE PREPARATION OF URANIUM CARBIDES
K. Yamamoto Aug. 1964 21 p refs Transl. into ENGLISH from Nippon Genshiryoku Gakkaishi (Tokyo), vol. 6, no. 3, 1964 p 134–143
(AERE-TRANS-1021) HMSO: 3s 6d

By heating the mixture of UO_2 and graphite in vacuum at 1600° to 2000° C, UC, or UC_2 without unreacted UO_2 was obtained. Each carbide was milled in hexane, compacted into shapes in argon atmosphere and sintered in vacuum (10^{-4}mmHg) at 1800° to 2000° C. High purity and high density pellets were thus obtained. Examining these sintered pellets by carbon analysis, metallographic observation, and X-ray diffraction, the following facts were revealed: (1) The UC sintered pellet had a monophase structure with a grain size of 50 ~ 100μ and the stoichiometric composition. (2) UC_2 sintered pellet was composed of UC_2 phase with grain size of 50 ~ 100μ and UC phase of about 10%. (3) Sinterability of UC_2 markedly decreased with increasing carbon content in the range of 8.6 to 8.9 wt%. This was attributed to the presence of free carbon. (4) Maximum carbon content of UC_2 phase at the temperature range of 1800° to 2500° C was determined as 8.6 ±0.1 wt%, that is, the composition of this phase could be expressed as $UC_{1.86 \pm 0.02}$. (5) The kinetics of transformation of cubic UC_2 to tetragonal one was regarded as a martensitic diffusionless one. Author

N65-25507# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE ANALYSIS OF PLUTONIUM–CHROMIUM CARBIDES
G. W. C. Milner, A. J. Wood, and G. Phillips Mar. 1965 16 p refs
(AERE-R-4859) HMSO: 2s 6d

Methods are described for the chemical analysis of plutonium–chromium carbides containing from 40% to 92% Pu, 4% to 40% Cr, and 3% to 8% C. Sintering with sodium peroxide is employed to dissolve samples either directly or after ignition to oxide. Controlled-potential coulometry is suitable for the direct determination of plutonium contents in 1 M H_2SO_4–0.01 M potassium pyrophosphate, the pyrophosphate being added to prevent the precipitation of chromium in the preparation of solutions for coulometry. Results are quantitative for 4 mg amounts of plutonium with a coefficient of variation of 0.2%. Chromium is determined by potentiometric titration after separation from plutonium by anion exchange from 8 M HNO_3 solutions. After oxidation with argentic oxide, the chromium is reduced with a slight excess of a standard ceric sulfate. Results are accurate for 1 mg amounts of chromium by this method with a coefficient of variation of 0.21%. Carbon is determined by combustion to carbon dioxide, followed by manometric measurement of the carbon dioxide produced. Vacuum fusion is suitable for the determination of any contamination of samples by oxygen and nitrogen. Author

N65-25509# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE DETERMINATION OF SELENIUM IN HAIR BY NEUTRON-ACTIVATION ANALYSIS
D. Betteridge Mar. 1965 16 p refs
(AERE-R-4881) HMSO: 2s 6d

Selenium in hair is determined by neutron-activation analysis by using the ^{80}Se (n,γ) $^{81,81m}Se$ reaction. After irradiation, the hair is decomposed in the presence of selenium carrier, containing selenium 75, and the selenium separated as the complex with 3,3'-diaminobenzidine. The chemical yield is determined by counting the selenium 75 when the activity of relatively short-lived selenium 81 and 81^m is negligible. Several samples of hair were analyzed for selenium, and the significance of the results is discussed. Author

N65-25519# Union Carbide Nuclear Co., Oak Ridge, Tenn.
SPARK-SOURCE MASS SPECTROMETRIC ANALYSIS OF COMMON AND RADIOGENIC LEAD
J. C. Franklin and E. B. Griffin 11 Jun. 1965 12 p
(Contract W-7405-ENG-26)
(Y-1481) CFSTI: $1.00

Spark-source mass spectrography has been utilized to provide a method of analysis that is fast and has extremely low levels of detection for more than 40 elements that may be present in lead. Author

N65-25527# Tufts Univ., Medford, Mass. Dept. of Chemistry
DIELECTRIC DISPERSION Quarterly Status Report, 1 Oct.–31 Dec. 1964
Karl H. Illinger [1964] 4 p
(Contract Nonr-494(19))
(QSR-14; AD-613933)

Theoretical treatment of microwave pressure broadening was applied to the study of the interaction between a polar diatomic molecule and an inert gas atom. An 8.2 to 40 kmc broadband microwave spectrometer, used in the study, was modified to increase its accuracy in measuring shapes and intensities of collision-broadened microwave lines. C.L.W.

N65-25533# Army Engineer Research and Development Labs., Fort Belvoir, Va.
TYPE OF GROWTH AND PROPERTIES OF LIQUID CRYSTALS OF THIAZINE DYES [FORMA ROSTA I SVOYSTVA ZHIDKIKH KRISTALLOV TIAZINOVYKH KRASITELEY]
N. M. Melankholin [1965] 12 p refs Transl. into ENGLISH from Tr. Inst. Kristallogr., Akad. Nauk SSSR, v. 4, 1964 p 61–67
(ERDL-T-1783-65; AD-613985)

A study was made of the growth and transformations in liquid crystals of a number of thiazine dyes, and it was established that these processes are different in different dyes. The dyes examined were novomethylene blue, methylene green, methylene blue, toluidine blue, thionine blue, and thionine violet. TAB

N65-25534# Army Engineer Research and Development Labs., Fort Belvoir, Va.
VITRIFIED LIQUID–CRYSTAL FILMS [O ZASTEKLOVANNYKH ZHIDKOKRISTALLICHESKIKH PLENKAKH]
I. G. Chistyakov and Ye. A. Kosterin [1965] 10 p refs Transl. into ENGLISH from Tr. Inst. Kristallogr., Akad. Nauk SSSR, v. 4, 1964 p 68–73
(ERDL-TR-1782-65; AD-613986)

Results are given of a study of the textures of liquid crystals which had been vitrified in the form of films. Substances of the ethyl p-n-dimethylaminobenzene-1-aminonaphthalene-4-azobenzoate and cholesteryl cinnamate types were examined. TAB

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N65-24449# Army Electronics Lab., Fort Monmouth, N. J. Exploratory Research Div. C

ELECTRICAL PERFORMANCE DATA OF EXPERIMENTAL DIELECTRIC-TUBE ANTENNAS

William Kennebec Feb. 1965 60 p ref

(ECOM-2557; AD-613283)

The performance characteristics of experimental fiber glass-tube microwave antennas are reported. Their implications regarding future microwave antenna designs and improvement of existing antennas are discussed. Author

N65-24470# Dewey (G. C.) Corp., New York.

AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF RADIATION ON THE PROPAGATION OF ELECTROMAGNETIC SIGNALS IN AIR

M. N. Hirsh, P. N. Eisner, and J. A. Slevin 30 Nov. 1964 88 p refs

(Contract DA-28-043-AMC-00457(E))

(R-190-1; AD-463020)

This report presents results of measurements obtained in N_2–O_2 mixtures weakly ionized by 1.5-MeV electrons. From a combination of steady-state and afterglow ionization measurements in a large uhf resonant cavity, these electron reactions were identified and appropriate rate constants evaluated: (1) production by collisions of beam and secondary electrons with neutral N_2 and O_2 molecules, with rates coefficients $K_N = 4 \times 10^{11}$ and $K_O = 6 \times 10^{11}$ ion pair [cm^3 sec torr ($\mu amp/cm^2$)]$^{-1}$, respectively; (2) three-body attachment of electrons to neutral O_2 molecules, with rate coefficient $\beta_o = (2.26 \pm 0.15) \times 10^{-30}$ cm^6/sec with O_2 as third body—an upper limit for efficiency of N_2 relative to O_2 as the third body is 0.08; (3) diffusion of electrons to the walls under the combined space charge field of positive and negative ions—agreement with measurements obtained by assumptions of 55 cm^2/sec as free diffusion coefficient of positive ions at 1 torr, and loss of negative ions by recombination with positive ions with rate coefficient 1×10^{-7} cm^3/sec. Optical emissions in the wavelength region from 3000 to 6000 Å are tabulated for N_2 and N_2:O_2 mixtures. Cyanogen emission in N_2, and its suppression by O_2, are described. The cross sections for quenching 1st negative (0,0) band at 3914 Å by collisions with N_2 and O_2 molecules are found $\sigma(N_2) = 1.4 \times 10^{-14} cm^2$, $\sigma(O_2) = 6 \times 10^{-14} cm^2$, respectively. Effects of gas composition on identities of the principal positive ions is described in light of mass spectrometer studies. Author

N65-24528 Joint Publications Research Service, Washington, D. C.

ON THE PROPAGATION OF STRONG RADIO-WAVES IN THE IONOSPHERE

E. I. Ginzburg *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 30–39 refs (See N65-24525 14-07) CFSTI: $7.00

The propagation of very strong radio waves in the lower ionosphere is analyzed. Formulas are derived for the change in amplitude of the field intensity due to the wave as the latter penetrates into a weakly ionized plasma. Author

N65-24529 Joint Publications Research Service, Washington, D. C.

ASYMPTOTIC SOLUTION OF THE MAXWELL EQUATIONS NEAR THE CAUSTIC SURFACE

Yu. A. Kravtsov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 40–50 refs (See N65-24525 14-07) CFSTI: $7.00

The method of geometrical optics is modified in such a way that it can be used to obtain the solution of Maxwell's equations in the vicinity of the caustic surface formed during the propagation of a wave in a heterogeneous medium. This modification consists in presenting the solution in a form which combines the exponential function with the Airy function (also its derivative). Expressions are derived for the amplitudes of the electric and magnetic fields, also for the angle by which the angle of polarization is rotated. The relation between these equations and the regular equations of geometrical optics is brought out. Author

N65-24537 Joint Publications Research Service, Washington, D. C.

SUCCESSIVE APPROXIMATIONS METHOD FOR CONSTRUCTING OPTIMUM ANTENNA ARRAYS

Yu. M. Zhidko *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 140–153 refs (See N65-24525 14-07) CFSTI: $7.00

A criterion is formulated for optimum antenna systems and is the generalization of the Dolf criterion for the case when the requirements on the side radiation level are different angular sectors. A simple method of successive approximations is described for the construction of optimum antenna arrays (arrays whose patterns satisfy the generalized Dolf criterion). This method may also be used for constructing optimum directional couplers, slot bridges, and other waveguide devices. The results of the numerical calculations of the optimum patterns are given. Author

N65-24538 Joint Publications Research Service, Washington, D. C.

FIELD OF A MAGNETIC DIPOLE COAXIAL WITH TWO DISKS

Ye. A. Ivanov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 154–176 refs (See N65-24525 14-07) CFSTI: $7.00

The strict solution is given for the problem on the diffraction of a field of an elementary magnetic dipole for two disks of different radii. An arbitrarily oriented dipole is located at any point on the axis of rotation which is common to both of the disks (also including the center of one of the disks). The solution is obtained as the sum of the solutions of two particular problems: the problem on the diffraction of a field of a vertical magnetic dipole at two disks and the problem on the diffraction of the field of a horizontal magnetic dipole. Author

N65-24544 Joint Publications Research Service, Washington, D. C.

BRIEF REPORTS AND LETTERS TO THE EDITORS: MEASUREMENT OF THE ABSORPTION OF RADIO WAVES IN ATMOSPHERE AT AN ALTITUDE OF 3,200 METERS ABOVE SEA LEVEL ON THE 1.6-CENTIMETER WAVELENGTH

S. A. Kamenskaya and K. S. Stankevich *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 227–229 ref (See N65-24525 14-07) CFSTI: $7.00

Absorption on the 1.6-centimeter wavelength was measured by the natural thermal radio emission of the atmosphere at an altitude of 3200 meters above sea level to obtain altitude characteristics of the absorption. A vertical distribution

of the temperature of the radio emission of the atmosphere was plotted in the altitude interval from 30° to 5°. The radio telescope had a radiation pattern of 36 ft in width for the half-power level and sensitivity of the order of several degrees with a time constant of 1 second. Brightness temperature of the radio emission of the atmosphere was determined by comparing the antenna temperatures during reception of the atmosphere and the radio emission of an absolutely black mountain located in the Fraunhofer region of the antenna and covering the entire major lobe of the radiation pattern. Blackness of the radio emission of the mountain was checked by the radio emission of a disk made of an absorbing material and having angular dimensions of 35 ft, which was also in the Fraunhofer region. Author

N65-24545 Joint Publications Research Service, Washington, D. C.

ON THE DIRECTION OF A BEAM AND ON THE GROUP VELOCITY IN AN ABSORBING ANISOTROPIC MEDIUM

K. A. Barsukov and V. L. Ginzburg *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 230–234 refs (See N65-24525 14-07) CFSTI: $7.00

A theoretical analysis of pulse propagation and group velocity in an absorbing anisotropic medium, which focuses on the direction of pulse movement, is presented. Formulas are included which support the hypothesis that no universal direction of the pulse beam exists in an absorbing medium. A mathematical analysis of one-dimensional pulse propagation and the incidence of a monochromatic pulse beam of light on a plate is included in support of this hypothesis. Also considered is wave propagation in an arbitrary linear medium without external field sources, in a transparent medium, and a nontransparent medium. S.C.W.

N65-24549 Joint Publications Research Service, Washington, D. C.

ON THE EFFECT OF THE FLUCTUATION IN THE TRANSFER VELOCITY OF THE INHOMOGENEITIES ON STATISTICAL CHARACTERISTICS OF A WAVE PROPAGATING IN A TURBULENT MEDIUM

G. A. Andreyev *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 251–255 refs (See N65-24525 14-07) CFSTI: $7.00

An analysis of the effect of fluctuations in the transfer velocity of inhomogeneities on time statistical characteristics of a wave propagating in a turbulent medium, which is designed to test the validity of the frozen turbulence hypothesis concerning the constancy of the transfer velocity, is presented. Based on calculations of the coefficient of the space–time transverse correlation of fluctuations in the logarithm of the amplitude of a plane monochromatic wave propagating in a turbulent medium, it is shown that the abandonment of the transfer velocity constancy along with the complete conservation of the invariability of the inhomogeneities in time (frozen turbulence) leads to a change in the space–time correlation coefficient. Results also show that the fluctuations in the transfer velocity reduce the correlation of the signal fluctuations observed at two points of space. S.C.W.

N65-24554 Joint Publications Research Service, Washington, D. C.

DIFFRACTION OF AN ELECTROMAGNETIC WAVE ON A PLANE METAL ARRAY OF SPECIAL CONFIGURATION WITH A DIELECTRIC AND SCREEN (THE CASE OF NORMAL INCIDENCE)

L. N. Litvinenko *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 275–280 refs (See N65-24525 14-07) CFSTI: $7.00

A theoretical analysis of the diffraction of a normally incident electromagnetic wave on an array with a special configuration and an adjoining dielectric layer; a screened array with a dielectric filling between the array and the screen; and an array with a dielectric layer without a screen is presented. Discussed is a method for determining the wave amplitudes of the diffraction spectrum for all conditions. S.C.W.

N65-24581# Army Missile Command, Huntsville, Ala. Advanced Systems Lab.

A DIGITAL COMPUTER PROGRAM FOR DETERMINING THE PERFORMANCE OF AN ACQUISITION RADAR THROUGH APPLICATION OF RADAR DETECTION PROBABILITY THEORY

Robert R. Boothe 31 Dec. 1964 40 p refs
(RD-TR-64-2; AD-462473)

The theory utilized is that reported by J. I. Marcum. The report discusses this theory and its application to the computer program. The probability of detection is calculated for both single-scan and cumulative probability for a ballistic target or aircraft on a point-by-point basis until a predetermined level is achieved. The radar cross section of the target, antenna gain patterns, and sensitivity time control are utilized as functions rather than as fixed input parameters. Ballistic trajectory data are read into the computer from peripheral magnetic tape units, while aircraft flight paths are machine generated internally. Author

N65-24598# Lincoln Lab., Mass. Inst. of Tech., Lexington.

LIMITED NETWORK PROCESSING OF SEISMIC SIGNALS

E. J. Kelly, Jr. 4 Sep. 1964 26 p ref *Its* Group Rept.-1964–44
(Contract AF 19(628)-500)
(ESD-TDR-64-369; AD-447220)

In processing data from a large seismic array, there is a need for rapid determination of source epicenter using only data from the array itself. It is shown how this may be accomplished using the peripheral elements of the array to form a seismic network of limited extent. The method of processing is derived as a limiting case of the classical method of epicenter determination using a worldwide network, and the expected accuracy of performance evaluated by error analysis. Results presented agree with theoretical expectations. Author

N65-24612# Aberdeen Proving Ground, Md. Ballistic Research Labs.

HIGH "G" UHF TELEMETRY FOR GUN-LAUNCHED SOUNDING PROBES

William J. Cruickshank Jan. 1965 37 p refs
(BRL-MR-1632; AD-463928)

The development of a uhf telemetry system that will withstand the high shock (50 000 g) of gun-launched vertical sounding probes is described. The associated development of a ground based automatic angle and range tracking and receiving system using a modified AN/GMD-1A Rawin set is also presented. Author

N65-24627*# National Aeronautics and Space Administration, Washington, D. C.

THE THEORY OF CROSS-MODULATION OF RADIOWAVES [K TEORII KROSSMODULYATSII RADIOVOLN]

A. V. Gurevich May 1965 23 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 1, no. 5/6, 1958 P 17–28
(NASA-TT-F-259) CFSTI: HC $1.00/MF $0.50

The percentage of cross modulation in a strong interfering wave is examined as a function of the radiated power

of the interfering station. Also considered are cross modulation resonance near the gyrofrequency and the influence of the electron velocity distribution on the phase of the cross modulation. Author

N65-24716# National Bureau of Standards, Boulder, Colo.
THE LARGE 50 MC/S DIPOLE ARRAY AT JICAMARCA RADAR OBSERVATORY
Gerard R. Ochs 5 Mar. 1965 66 p refs
(NBS-8772)

A vertically directed antenna having a square aperture of 84 000 square meters was constructed near Lima, Peru, for electron density measurements of the ionosphere and exosphere. It consists of two superimposed arrays of half-wave dipoles at right angles to each other, placed 0.3 wavelength above a reflecting screen of poultry netting. The half-power beamwidth of the antenna is 1.06° and the measured onaxis gain is 0.63, that of a perfect uniformly illuminated aperture of this size. Author

N65-24719*# Spacelabs, Inc., Van Nuys, Calif.
WIRELESS EAR MICROPHONE INTERCOMMUNICATION SYSTEM Final Report
16 Apr. 1965 64 p
(Contract NAS9-2777)
(NASA-CR-65021; SR65-1018) CFSTI: HC $3.00/MF $0.75

The design, fabrication, and testing of a wireless ear microphone communication system is presented. The system consists of a miniature ear microphone transceiver and a master station. The transceiver senses speech sounds in the ear canal with an acoustic transducer and transmits through a radiofrequency link to the master station. The same transducer converts radio signals received to audio. The advantages are small size, hands-off operation, and improved performance in high noise environments. The design phase includes system and transducer selection, insert test and selection, and transceiver, diplexing, and master station design. The packaging design, in an ear mounted configuration, was based on microcircuit fabrication although dense welded construction was used. Test results for microphone sensitivity, diplexer gain and isolation, transceiver timing the performance parameters, and master station overall performance are summarized. Photos and schematic circuit diagrams are included. R.N.A.

N65-24725# Cornell Aeronautical Lab., Inc., Buffalo, N. Y. Electronics Research Dept.
SOME CONSIDERATIONS FOR THE INVESTIGATION OF ELECTROMAGNETIC PROPAGATION THROUGH REENTRY PLASMAS
Marley E. Bechtel Jul. 1964 16 p refs
(CAL-ER/RIS-4)

This report presents some considerations in planning an experimental and analytical investigation of radiowave propagation from a reentry vehicle surrounded by ionized gas. A major departure from previous investigations of this type is the recognition that electromagnetic transmission measurements based on free-space antenna concepts and simple ray theory may be unacceptable because of the markedly nonuniform space distribution of complex dielectric permittivity. Experiments in a high-energy shock tunnel would determine the amplitude and phase properties of the transmission path. Analysis to permit data interpretation is essential because of the impossibility of exactly scaling all pertinent parameters. Author

N65-24734# Weapons Research Establishment (Australia).
POLARIZATION CHARACTERISTICS OF MONOPOLES MOUNTED RADIALLY ON THREE-QUARTER WAVELENGTH DIAMETER CYLINDERS
L. A. Nicholls and J. R. Pyle Jan. 1965 49 p refs
(WRE-PAD-15)

The purpose was to determine (1) the extent to which the plane of polarization of the monopoles in free space is twisted due to the scattering effect of the cylinder and (2) the ellipticity of the total electric field. Former results indicate the size of errors which may be expected with the Roll Telemetry system used to determine missile roll attitude, and point to a difficulty in applying corrective calibrations. Latter results indicate the amount of distortion of waveform shape expected in the Roll Telemetry records, with corresponding degradation of reading accuracy. Results obtained from measurements in a microwave anechoic chamber are supplemented by computed results for the case of an infinite cylinder, for which theoretical expressions for the electromagnetic fields may be simply derived. Author

N65-24749# Radio Corp. of America, Moorestown, N. J. Missile and Surface Radar Div.
SCALE MODEL RADAR CROSS SECTION DATA (SPACETRACK O & M SIGNATURE ANALYSIS PROGRAM)
L. H. Lenert 31 May 1963 85 p
(Contract AF 19(628)-536)
(AD-460987)

Radar cross-section curves are presented for various satellite payload and tank-type bodies. The bodies under consideration are bodies of revolution. Two classes of body shapes are considered—simple (cones, spheres, cylinders, etc.) and complex (constructed by mating the sample shapes into various configurations). Author

N65-24779# Raytheon Co., Wayland, Mass. Advanced Development Lab.
NEWBURYPORT ANTENNA: TEST RESULTS Final Report, Aug. 1962–Sep. 1964
John E. Walsh and Neil F. Lacey 1 Dec. 1964 32 p
(Contract AF 19(628)-496)
(AFCRL-64-987; AD-612789)

Results are reported of some flight tests performed on the Newburyport antenna, a 3500-foot, multiplicative scanning array operating at 30 to 50 Mc/sec and providing multiple receiving beams one-half degree wide in azimuth. Calibration and testing procedures are described, with particular reference to patterns taken by focusing in the near field. Test results were encouraging but not conclusive, and emphasize the existence of major difficulties in the assessment of characteristics of directive antennas at frequencies below uhf. Author

N65-24804# Lenkurt Electric Co., Inc., San Carlos, Calif.
INTERCONNECTING NETWORK OA-7181(XW-1)/FCC-17 OA-7182(XW-1)/FCC-17 AND OA-7183(XW-1)/FCC-17 (GROUP INTERCONNECT NETWORKS), PHASE A Final Engineering Report
Forrest Easley and T. R. Holmes 30 Oct. 1964 31 p
(Contract AF 30(635)-11188)
(RADC-TDR-64-371, Vol. 1; AD-461672)

Design and development problems are summarized, and a detailed theoretical discussion of the group interconnect network is given. The group interconnect network was designed

to allow interconnection of twelve-channel groups at the 60- to 108-kc group frequency band without the necessity of using channel equipment to demodulate to voice frequency. The predicted mean-time-between-failure of the group interconnect network is 19 000 hours with an estimated point availability of 99.998 percent. Author

N65-24833# Lenkurt Electric Co., Inc., San Carlos, Calif.
PHASE A TECHNICAL REPORT: RESEARCH AND DEVELOPMENT REPORT FOR MULTIPLEXER SET AN/FCC-17
R. B. Anderson, J. R. Morison, L. C. Chase, and J. H. Smith
Griffiss AFB, N. Y., RADC, 30 Oct. 1964 402 p refs
(Contract AF 30(635)-11188)
(RADC-TDR-63-440, Vol. 1; AD-461675)

Studies in multiplexer set development were concerned with transistorization, traffic requirements, frequency allocation plans, modulation plans, and reliability objectives. Mechanical packaging arrangements were designed to meet the requirements of both fixed office and tactical (mobile) installations. A rugged, fully transistorized, single-sideband, suppressed-carrier, frequency-division multiplexer set for use in global communications networks resulted. Numerous configurations of this equipment exist and the modular construction of the equipment permits facilities to be expanded from 12 to 600 two-way channels. Noise, crosstalk, envelope delay characteristics, and message power handling capabilities of the equipment are such that each channel is equally suitable for the transmission of voice, teletype, digital data, or graphic information. Requirements for transferring groups or supergroups into and out of foreign, domestic, military, or commercial systems are easily met whenever an end-to-end channel arrangement is not employed, and the reliability of this equipment is far superior to that of many similar equipments presently in use. Author

N65-24837# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
EXPERIMENTAL METHODS FOR MEASUREMENT OF RADAR BACKSCATTERING CROSS SECTIONS
John E. Terry 10 Aug. 1964 40 p refs
(RSIC-245; AD-462080)

This document is a compilation of most of the representative experimental methods for obtaining backscattering cross section measurements. A description of apparatus used and application of apparatus for each method is included. The methods discussed are standing-wave, doppler-shift, magic-t, space-separation, time-separation, fm radar, and two methods primarily for outdoor measurements. In addition to entries on backscattering measurements by experimental methods, the bibliography, containing 44 references, includes several entries which develop theoretical formulas on scattering cross sections of various objects. Author

N65-24844*# Electro-Mechanical Research, Inc., Sarasota, Fla.
MANNED SPACECRAFT ADVANCED TELEVISION STUDY Final Report
31 Jul. 1963 399 p refs
(Contract NAS9-991)
(NASA-CR-65012) CFSTI: HC $7.00/MF $2.00

A compressed digital television system for transmitting information from a manned spacecraft to earth is described. Eight separate equipment configurations were compared. Coding techniques, radiofrequency links, storage media comparisons, ground data scan conversion and recording, and digital television experiments were studied to determine the most suitable design for compatibility with future worldwide television ranges, and for operation with minimum spacecraft power drain consistent with an acceptable error rate at the earth receiving terminal. The system characteristics selected include a slow scan electrostatic vidicon sensor, 256-line resolution, quantization of 3 bits of PCM plus 4 bits of Roberts encoding, 15 frames per second, redundancy elimination by element-to-element using a previous element encoder, modified Huffman coding, 10^6 picture elements per second input rate, output rate constant at 2 megabits per second, videotape storage capable of 2 megabit read-in and 1.2 or 2 megabit read-out, TV-displays to TV-camera ground scan conversion, and semiconductor integrated circuitry or discrete miniaturized parts construction. R.N.A.

N65-24898*# ADCOM, Inc., Cambridge, Mass.
COMMAND SYSTEM STUDY FOR THE OPERATION AND CONTROL OF UNMANNED SCIENTIFIC SATELLITES. TASK II CLOSED-LOOP (FEEDBACK) VERIFICATION TECHNIQUES Second Quarterly Progress Report, 30 Sep.–31 Dec. 1964
J. Levy, A. M. Manders, and S. M. Sussman [1964] 41 p refs
(Contract NAS5-9705)
(NASA-CR-62965) CFSTI: HC $2.00/MF $0.50

Specific conclusions from analysis of feedback system performance, code structures, and telemetry link adaptation are: (1) One meaningful measure of error detection system performance is the probability, P_e, of an accepted codeword being in error. This error probability depends only on the uplink characteristics and on the code structure, but not on the feedback link. For a binary symmetric channel with transition probability p, P_e can be calculated from the codeword weight distribution, W(i), or from an approximation to W(i). (2) Cyclic codes for error detection can be altered to detect loss of synchronization by the addition of a fixed binary vector to each codeword prior to transmission. These codes are characterized by a pair of numbers [s, δ] such that a synchronization slip of s bits can be detected whenever each codeword contains less than δ errors. Multiple repetitions of cyclic codewords, appropriately altered, permit a considerable range of s and δ at some sacrifice in data rate. (3) Telemetry formats must be adapted to accept feedback information from the updata link. Author

N65-24929# Naval Research Lab., Washington, D. C.
THE EARLY HISTORY OF RADAR
R. M. Page *In* Smithsonian Inst. Ann. Rept. of the Smithsonian Inst., 1962 [1962] p 315–321 refs (See N65-24925 14-34) GPO: $4.75

The contemporary technology and scientific information which led to the innovation of radar is reviewed. The combination of five basic, already known, ideas which were fused to become radar are enumerated, and various proposals which lacked one or another of these basic ideas are reviewed. The development of pulse radar under the direction of the U.S. Navy led to a successful test of the first equipment in December 1934. Subsequent refinements throughout World War II of both receiving and transmitting equipment are described. At the beginning of the War, three parallel streams of development had evolved: the finest mobile ground-based radar came from the U.S. Army Signal Corps, the finest airborne radar came from the British Royal Air Force, and the finest naval radar came from the U.S. Navy. Photographs of early radar equipment are included. M.P.G.

N65-24991*# Electronic Communications, Inc., Timonium, Md. Research Div.
INVESTIGATION AND STUDY OF A MULTI-APERTURE ANTENNA SYSTEM Final Report, 1 Jan.–1 Apr. 1964

R. E. Feltman, W. C. Gore (Johns Hopkins Univ.), D. J. Lewinski, H. J. Peters, J. W. Sherman et al [1964] 212 p refs
(Contract NAS5-3472)
(NASA-CR-63082) CFSTI: HC $6.00/MF $1.25

A multiple aperture adaptive antenna system for application to receiving telemetered data from remote space vehicles or satellites was investigated. Many physical constraints imposed on both a single antenna and a multiple aperture system were evaluated. These include such factors as acquisition and combining of signals, look angle, shadowing, propagation influences, system spatial bandwidth, collimation, interference, Doppler effects, reliability, and noise. Specific conclusions were made for a system operating at a frequency of 2 Gc, but the system model adopted allows quick evaluation at other frequencies. At a frequency of 2 Gc, the crossover point between a single antenna or a multiple aperture configuration occurs for an 85-ft reflector. However, this transition region is not critical. For lunar range communications a single antenna appears to be the most economical, whereas at interplanetary ranges aperture equivalents of around 400 ft are required, and achieved by arraying eight 142-ft antennas.
Author

N65-24997*# General Electric Co., Philadelphia, Pa.
VOYAGER SPACECRAFT SYSTEM STUDY (PHASE I—TITAN IIIC LAUNCH VEHICLE), VOLUME IIb Final Report
7 Aug. 1964 264 p refs Prepared for JPL *Its* Doc. No. 64SD933
(Contracts NAS7-100; JPL-950847)
(NASA-CR-62957) CFSTI: HC $6.00/MF $1.50

Communications subsystems are analyzed and defined for the bus–lander, all-orbiter, and orbiter–lander vehicle configurations. Most techniques and component types are the same as those recommended in the previous Voyager design study for the Saturn 1-B launch vehicle; however, no relay capability is included in the all-orbiter or the lander of the bus–lander configuration in order to eliminate the dependence of the lander on the separately launched orbiter. All thermoplastic recorders (TPR's) have been replaced by magnetic tape recorders since TPR's as defined previously are not expected to be within the state-of-the-art in the required time period. System reliability, applicability, program plan, program cost, and schedule comparisons data are included.
S.C.W.

N65-24998*# General Electric Co., Phialdelphia, Pa. Spacecraft Dept.
VOYAGER SPACECRAFT SYSTEM STUDY (PHASE I—TITAN IIIC LAUNCH VEHICLE), VOLUME IIa Final Report
7 Aug. 1964 325 p refs Prepared for JPL *Its* Doc. No. 64SD933
(Contracts NAS7-100; JPL-950877)
(NASA-CR-62956) CFSTI: HC $7.00/MF $1.75

Presented are results obtained from a conceptual design study for a Voyager spacecraft to be launched by the Titan IIIC launch vehicle for orbiting and landing missions to Mars from 1971 to 1977. Emphasized in this study are the Bus/Lander and the orbiter spacecraft system design. Payload, communication modes and data rates, orbital, power profile and reliability data are included.
S.C.W.

N65-25001*# Bell Telephone Labs., Inc., New York.
NOTE ON THE MEAN ERROR AND STANDARD DEVIATION IN THE OUTPUT OF A LEAST SQUARE QUADRATIC FILTER—CASE 20061-1
J. G. Kreer 13 Jul. 1964 25 p ref
(NASA-CR-62884) CFSTI: HC $1.00/MF $0.50

The statistics of the output of a "least squares quadratic filter" are discussed, and expressions are derived for the means and standard deviations of the estimates of position, velocity, and acceleration, including effects of correlated noise. It is shown that the errors of the mean are of the form of a "dynamic tracking error" proportional to the third and fourth time derivative and to the square of the smoothing interval for the velocity and acceleration estimates and to its fourth power for the position estimates. The standard deviations are shown to vary inversely as the square root of the number of samples, as would be expected, and the standard deviation of the velocity estimate is inversely proportional to the smoothing period and that of the acceleration to the square of the smoothing period. All of these assume uncorrelated noise samples. Correlation introduces additional terms whose variation cannot be expressed as simply as above but depends upon the autocorrelation function of the noise.
Author

N65-25007*# Illinois Univ., Urbana. Electrical Engineering Research Lab.
DIFFRACTION OF RANDOM WAVES IN A HOMOGENEOUS ANISOTROPIC MEDIUM
K. C. Yeh Apr. 1965 15 p refs
(Grant NsG-24-59)
(NASA-CR-62894) CFSTI: HC $1.00/MF $0.50

The diffraction of random waves in a homogeneous anisotropic medium is considered. These waves are produced by reflection from a rough surface, such as the moon, or by transmission through ionospheric irregularities. Due to anisotropy, both depolarization effect and the modification of spectral density functions of the wave by the medium may occur. Both may be important in certain ionospheric applications. In the forward-scatter approximation it was found that the sum of spectra of orthogonally polarized waves is uninfluenced by the medium.
Author

N65-25013# National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
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N65-25017 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.

A MICROWAVE BEACON ANTENNA OF NOVEL DESIGN

W. A. Cumming *In its* Bull. of the Radio and Elec. Eng. Div., V. 14, No. 3, Jul.–Sep. 1964 [1964] p 11–13 refs (See N65-25013 14-07)

The development of a new beacon antenna suitable for microwave use, which was designed to overcome some of the limitations of existing designs, is reported. The beacon consists of a circular waveguide illuminating a paraboloidal reflector, which in turn is directed at a 45° cone. The model has a base diameter of 12 in., a vertical aperture of 7 in., and was tested at a center frequency of 16 gc/s. Results of excitation of the circular waveguide at either the mode which produces vertical polarization, or the mode which produces horizontal polarization, showed that in both cases the circular waveguide aperture was approximately 1.5λ at midband, producing a hollow cone of radiation with a peak cone some 30° off the feed axis. Azimuth and elevation patterns for both modes are illustrated. All patterns were obtained with the phase center of the feed located on the focal point of the paraboloid. S.C.W.

N65-25018 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.

AN AMPLITUDE-MODULATED END-FIRE ARRAY

Kiyoshi Nagai *In its* Bull. of the Radio and Elec. Eng. Div., V. 14, No. 3, Jul.–Sep. 1964 [1964] p 13–17 refs (See N65-25013 14-07)

A theoretical analysis of an isolated condition for the maximum gain of an end fire array, consisting of a line of isotropic radiators with a sine-modulated amplitude current distribution, and on which the phase velocity is assumed to be constant, is reported. Based on the assumption that the current on each isotropic radiator can be represented by $I(Z) = I_0(1 - m \cdot \cos\eta Z)e^{-j\beta Z}$, where m = modulation coefficient; β = wave number along the end fire array = $\frac{2\pi}{\lambda g}$; $\eta = \frac{2\pi}{\lambda m}$, where λm = wavelength of the modulation, and k = wave number in free space = $\frac{2\pi}{\lambda_0}$; a sample calculation of the array was chosen as 40 wavelengths ($2L = 40\lambda_0$). It is shown that the $40\lambda_0$ modulated end fire array has a maximum gain of 26.8 dB over an isotropic radiator at $\eta = 0.0500$ k, compared with a gain of only 24.6 dB for an array of constant amplitude distribution which satisfies the Hansen–Woodyard condition. S.C.W.

N65-25020 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.

HIGH-FREQUENCY RADIO DIRECTION FINDING

N. Burtnyk and J. Wolfe *In its* Bull. of the Radio and Elec. Eng. Div., V. 14, No. 3, Jul.–Sep. 1964 [1964] p 20–27 refs (See N65-25013 14-07)

The development of a design procedure for a high frequency radio direction finder using a wide aperture interferometer system is reported. Presented are results of a performance evaluation of a crossed interferometer of 122.5-meter spacing, and a receiving system employing an 800-foot 31-element linear array, antenna switching, a compact data logging computer system, and a data processing method utilizing vector addition. S.C.W.

N65-25021 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.

INNOVATIONS IN THE AURORAL RADAR SYSTEM FOR IQSY

A. G. Mc Namara *In its* Bull. of the Radio and Elec. Eng. Div., V. 14, No. 3, Jul.–Sep. 1964 [1964] p 27–30 (See N65-25013 14-07)

Reported are new developments in the auroral radar system for the International Quiet Sun Years (IQSY) 1964 to 1965. Cited are the development of new radar equipment which automatically processes radar video signals and reduces them to digital form on punched tapes for later processing on a digital computer; and the development of a rotating antenna system with transmit–receive capability and low back-lobe and side-lobe response, which reduced back- and side-lobe responses at Arctic stations to negligible portions. Included are a diagram illustrating auroral radar echoes observed with the new antenna system, and a graph which shows the measured antenna radiation pattern in the azimuthal plane. S.C.W.

N65-25022 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.

SOME POLARIZATION CHARACTERISTICS OF SOLAR RADIO EMISSION AT 74 MC/S DURING THE SEPTEMBER 1963 NOISE STORM

L. R. Mc Narry *In its* Bull. of the Radio and Elec. Eng. Div., V. 14, No. 3, Jul.–Sep. 1964 [1964] p 30–33 refs (See N65-25013 14-07)

An analysis of several polarization characteristics of solar radio emission at 74 Mc/s during the September 1963 noise storm is presented. Results of calculations of the degree of polarization, the axial ratio of the polarization ellipse, and the orientation of the major axis of the ellipse are included. A time sharing radio polarimeter operating at 74 Mc/s was used to obtain polarization data. S.C.W.

N65-25032 Joint Publications Research Service, Washington, D. C.

ESTIMATE OF THE RELIABILITY OF COMMUNICATIONS DEVICES AND PROBLEMS IN THE CONSTRUCTION OF RELIABLE DEVICES

A. K. Kel'mans *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 1–22 refs (See N65-25031 14-10) CFSTI: $8.28

A polygon model which describes communications systems having a number of stations (or devices) through which messages may pass, or at which messages may become distorted or terminated, is presented for analysis of system reliability. Disparity in the data transmitted by different sources, the possible sporadic nature of the transmission, differences in reliability of the devices, and repair time for the devices, are factors considered in this study. As reliability criteria, both the concept of average losses in the system and the probability of certain increases in losses are investigated. A computing algorithm is given for determining the communication system which is optimal with respect to the effort required to maintain specified levels of reliability. J.M.D.

N65-25033 Joint Publications Research Service, Washington, D. C.

ESTIMATING THE PARAMETERS FOR THE PASSAGE OF REPORTS THROUGH A CHANNEL WITH GIVEN RELIABILITY CHARACTERISTICS OF THE REALIZING EQUIPMENT

O. I. Bronshteyn *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 23–29 refs (See N65-25031 14-10) CFSTI: $8.28

For a communications model which consists of a linear series of stations, each of which may break down and cause

a delay in message transmission, conditions of steady-state operation are studied. Each station is characterized by its potential for permitting message flow, and by its exponential distribution of times required for repair. Probabilities of the various states of steady-state function are developed in terms of these two characteristic parameters. J.M.D.

N65-25053 Joint Publications Research Service, Washington, D. C.
SUCCESSIVE METHOD OF SPECTRAL ANALYSIS WITH RESPECT TO SPEECH SIGNALS
R. S. Dadashev *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 277–288 refs (See N65-25031 14-10) CFSTI: $8.28

Analysis of speech signals rests on the determination of the current and the instantaneous spectra of the signal by the expansion of the complex oscillations into spectrum components. This can be carried out by (1) simultaneous analysis of the oscillations by a set of resonators tuned to various frequencies, and (2) sequential analysis of the oscillations where the entire investigated spectrum moves along a fixed scale of resonance frequencies. Described is a functional diagram and certain working relationships of a spectral analyzer for the sequential spectral analysis of speech signals. It incorporates a step sawtooth voltage, composed of broken lines, for frequency pumping, thus eliminating amplitude distortions and the transient processes in the filter caused by the sliding frequency. This apparatus uses the scanning cycle of the step sawtooth voltage to obtain the instantaneous and flowing spectra of the speech signals directly from the output of the integrator with simultaneously changed time. G.G.

N65-25059 Joint Publications Research Service, Washington, D. C.
METHOD FOR CONSTRUCTING A CODE WITH AN ASSIGNED CODE DISTANCE
A. S. Ipatov *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 370–375 refs (See N65-25031 14-10) CFSTI: $8.28

Based on an error correcting code model in which the code distance is 2d + 1 where d is the number of corrected errors out of the 2d which are detected, a method is present for constructing codes with assigned numbers of code words and specified code distance. A code produced by this method is systematic and may be converted to a linear code by an isomorphic transformation. Determination of the combination of associated codes which minimizes the length of the resulting code word is discussed. J.M.D.

N65-25064 Joint Publications Research Service, Washington, D. C.
SCANNING TRACKERS WITH A DOVE PRISM
Ye. P. Chubarov *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 459–479 refs (See N65-25031 14-10) CFSTI: $8.28

Three scanning devices are considered which can be used as mismatch transducers for tracking systems. A mismatch signal occurs when the optical axis of a system is displaced with respect to the direction of the light source; the transducer relays the signal to a servomechanism which can adjust the position of the axis. In the particular devices under discussion, the mismatch signal is formed through rotation of the image field by revolving Dove prisms. They are proposed for tracking radiation sources in the spectral range from 0.1 to 4.2 Mc, with the advantages of long operating life, low voltage requirements, low cost of elements, small temperature effects, and absence of a dependency between signal readings and the voltage. J.M.D.

N65-25066 Joint Publications Research Service, Washington, D. C.
PHOTOELECTRIC SCANNING WITH AUTOMATIC SCANNING AND TRACKING DEVICES USING THE METHOD OF ZONAL-ELEMENT SCANNING
V. A. Strokov *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 493–506 refs (See N65-25031 14-10) CFSTI: $8.28

Photoelectric devices for automatic scanning and tracking of luminescent objects are discussed. These devices do not have certain disadvantages of optical-mechanical scanners, namely the necessity for complicated circuits, and moving parts which bring about energy losses and consequent inaccuracies. The read-out time for useful information about the object under observation is substantially less than for optical–mechanical systems; this reduction is accomplished by means of optimum scanning of the analyzed field. The zonal scanning technique for one such photoelectric device, which reduces the time required to detect the object, is described. J.M.D.

N65-25070 Joint Publications Research Service, Washington, D. C.
RADAR DETECTION AND INTERFERENCE
Chang Lien *In its* Transl. on Communist China's Sci. and Technol., No. 180 17 May 1965 p 15–25 Transl. into ENGLISH from Wu-hsien-tien Chi-shu (Peking), no. 3, 11 Sep 1964 p 1–5 (See N65-25069 14-34) CFSTI: $3.00

A discussion of the primary problems of radar detection and radar interference is presented. Analyzed are the energy utilization rate of the range of interference, and the primary characteristics and developmental trends of interference and radar detection equipment. S.C.W.

N65-25071 Joint Publications Research Service, Washington, D. C.
RADAR DETECTION AND INTERFERENCE (CONTINUATION)
Chang Lien *In its* Transl. on Communist China's Sci. and Technol., No. 180 17 May 1965 p 26–34 Transl. into ENGLISH from Wu-hsien-tien Chi-shu (Peking), no. 4, Oct. 1964 p 4–7, 10 (See N65-25069 14-34) CFSTI: $3.00

Continued research on radar detection and interference is reported. Presented is an analysis of detection probability in respect to antenna interception probability and the detection probability of the receiver. The detection probability of search radar and tracking radar are exemplified. It is shown that several minutes are required for ordinary search radar detection while several seconds are required for tracking radar. Included are data on the interception probability within a radar antenna and detection antenna revolving period, the mean interception time, the detection probability of the receiving set, radar parameters, detection equipment parameters, the use of the frequency scanning method and combined broad and narrowbands to raise the detection probability of the receiving set, signal blurring, and the development of detection techniques. Also considered are methods of categorizing and classifying interference. Cited are disturbed, cheating, concealed, positive, and limited interference. S.C.W.

N65-25074 Joint Publications Research Service, Washington, D. C.
EVALUATION ACTIVITIES OF ALL-CHINA RADIO RECEIVERS IN 1964
In its Transl. on Communist China's Sci. and Technol., No. 180 17 May 1965 p 59–61 Transl. into ENGLISH from Wu-hsien-tien Chi-shu (Peking), No. 4, Oct. 1964 p 41 (See N65-25069 14-34) CFSTI: $3.00

A translation of photo captions concerning evaluation activities of All-China radio receivers in 1964, which appeared

in the Chinese language periodical *Radio Technology*, is presented. Included are photographs of evaluation activities executed in the radio receiver exhibition room, and the radio receiver listening laboratory in which the fidelity of radio receivers was evaluated. Also included are photos of the latest design in radio receivers. S.C.W.

N65-25075# IIT Research Inst., Chicago, Ill.
PROCEEDINGS OF THE TENTH TRI-SERVICE CONFERENCE ON ELECTROMAGNETIC COMPATIBILITY
[1964] 862 p refs Conf. held at the Museum of Sci. and Ind., Chicago, 17–19 Nov. 1964 sponsored by Army, Navy and AF
(Contract DA-28-043-AMC-00226(E))
(AD-615627)

A compilation of papers on electromagnetic compatibility, instrumentation, prediction, measurement techniques, cable coupling and shielding, interference reduction techniques, antennas, power transients, and specifications and specification testing is presented. For individual titles see N65-25076 to N65-25113.

N65-25076 Genistron, Inc., Los Angeles, Calif.
A NATIONAL POLICY FOR ELECTROMAGNETIC COMPATIBILITY
F. J. Nichols *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 9–14 (See N65-25075 14-07)

The need for a national policy to coordinate the present and future requirements of civilian, military and space research to assure full utilization of the radiofrequency (rf) spectrum is presented. For full electromagnetic compatibility, various levels of control that are necessary and must be considered are components and subsystems, systems, intersystem or interfaces in major systems, system-to-environment or environment-to-systems or -interfaces, and utilization and conservation of the rf spectrum. Progress on the first four levels was illustrated by present USAF and Electromagnetic Compatibility Analysis Center activities; the fifth point is an outgrowth of the first four since every major military, NASA, and civilian electronic system utilizes the rf spectrum. The problems associated with future frequency assignments are discussed to show the urgent need for a national policy. R.W.H.

N65-25078 Rome Air Development Center, Griffiss AFB, N. Y.
LOSS OF SYSTEM EFFECTIVENESS DUE TO ELECTROMAGNETIC INTERFERENCE
C. L. Hudson and W. R. Limburg *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 28–57 refs (See N65-25075 14-07)

To validate the interference analysis and prediction process and to make it useful to the system users requires the quantitative determination of system degradation due to different types and intensities of electromagnetic interference. To determine degradation, or the loss of system effectiveness caused by interference, controlled laboratory experiments were conducted on a typical search radar system (FPS-8) and a typical am voice communications receiver (R-278B/GRC-27). Test objectives were (1) to determine the relationship between level and type of interference and the degree of information degradation at the system output and (2) to convert data on interference effects into meaningful language for the system user. An important part of these tests was the development of measurement techniques and evaluation of equipment used to determine the intelligibility of voice signals. Data comparing the performance of the Voice Interference Analysis Set, with the Speech Communications Index Meter is presented and discussed. Author

N65-25079 National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
EMC CONTROL EFFORT ON THE ACE-S/C SYSTEM (APOLLO PROGRAM)
N. Ball and H. Hoffart (Gen. Elec. Co., Daytona Beach, Fla.) *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 58–76 refs (See N65-25075 14-07)

A new EMC control concept was evolved, utilizing an isolated radial instrumentation earth ground in addition to the conventional power-building ground grid network. Twin tubular copper buses were used; one static ground for all RFI-type enclosures, and the other zero potential reference for signal circuits. Each of the over one hundred RFI shielded enclosures contain individual full length signal and static ground buses with the signal ground bus exiting via a waveguide. Commercially available electronic equipment was modified for use with separate signal and static ground connections. Absorptive-type interference reduction filters, rather than lumped constant networks, were used on all ac power circuits in conjunction with electrostatically shielded transformers to control conducted spurious energy. The EMC control program and its advantages and conformance to specifications are presented. Author

N65-25080 IIT Research Inst., Chicago, Ill.
ENVIRONMENT-GENERATED INTERMODULATION IN COMMUNICATION COMPLEXES
J. J. Krstansky and R. F. Elsner *In its* Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 77–99 (See N65-25075 14-07)
(Contracts N123(953)30698A; N123(953)35417A)

Environment-generated intermodulation is a problem that was overlooked because of the relative simplicity of transmitting/receiving installations. With the advent of large communication complexes, the number of possible interfering frequencies increases greatly. As the orders of intermodulation increase, their amplitudes decrease and the number of interfering frequencies increases with increased number of simultaneously radiating transmitters. Amplitudes of these signals were found to be variable and difficult to predict for complex environments. The interfering effects of environment-generated intermodulation were reduced by limiting the number of simultaneously radiating transmitters. Further research is being conducted to refine the techniques of prediction and intermodulation source location. R.W.H.

N65-25081 Boeing Co., Seattle, Wash.
EVALUATION OF SYSTEM ELECTROCOMPATIBILITY
R. Goldman, E. D. Knowles, J. E. Maynard, B. E. Roseberry, and R. B. Schulz *In* ITT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 100–111 (See N65-25075 14-07)

Presented is a discussion of the pros and cons of four basic methods for planning system electrocompatibility tests and the demonstration of a safety margin. Results of a comparative study showed that although each method has a preferred area of application, a combination of methods C, which has high-frequency restrictions but which is readily applicable to the measurement and processing of interference signals on power lines; and D, which is suitable for application to signal cables, digital or analog, will yield immediate and positive information on specification compliance with margin-of-safety requirements. Among the other advantages emphasized are that such a combination will permit a decision on specification compliance, based upon measurements of reasonably realistic test signals, rather than detection by techniques whereby vital information about the interference signal has been irretrievably lost. S.C.W.

N65-25082 Georgia Inst. of Tech., Atlanta. Engineering Experiment Station

CONSIDERATIONS IN THE DESIGN OF A RADIO FREQUENCY COMPATIBILITY (RFC) TEST SET

H. W. Denny *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 112–130 refs (See N65-25075 14-07)

(Contract DA-36-039-AMC-02223(E))

This accessory set is designed to be compatible with available signal generators and interference measuring sets. Though the set was designed for the establishment of test setups in accordance with MIL-I-11748, little modification would be required to provide this capability as outlined in other specifications. A discussion is given on the combination of several test setups into a single arrangement requiring a minimum of operator adjustment. The use of rf switches to minimize interconnections is described. Various accessory items are discussed in view of the requirements of the test set. Author

N65-25084 Bendix Corp., Baltimore, Md. Radio Div.

A NEW APPROACH TO RADAR SPECTRUM SIGNATURE RECORDING

A. E. F. Grempler and A. P. Carlson (RADC) *In its* Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 151–159 (See N65-25075 14-07)

The construction and operation of the AN/FSM-17(XW-1) Radiation Pattern Recorder are discussed; the FSM-17 is in current use. Author

N65-25086 Bell Aerosystems Co., Fort Huachuca, Ariz.

EQUIPMENT OPERATIONAL PARAMETER VARIABILITY

L. F. Babcock *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 187–211

Variations in major electronic communication equipment parameters affect equipment compatibility. The magnitude of the effect can be determined only after the size of the variation is known. Certain parameters are measured during routine EMETF field tests, and data are therefore available to show the distribution of these parameters for a significant equipment sample size over extended periods of time. Measurement procedures are explained. Histograms are presented to show the distribution of transmitter power, frequency, modulation or deviation, and receiver sensitivity for several types of modern Army equipment. The corresponding information available from spectrum signature measurements is also given. It is concluded that significant parameter variations exist, and that additional data from representative quantities of operational equipment are required to more fully establish the variations which exist in normal usage. Author

N65-25088 IIT Research Inst., Annapolis, Md. Electromagnetic Compatibility Analysis Center

PERFORMANCE DEGRADATION CONCEPTS IN GROUND TERMINAL SATELLITE TRACKING AND COMMUNICATIONS SYSTEMS

M. D. Aasen *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 236–254 refs (See N65-25075 14-07)

(Contract AF 19(628)-4154)

Mathematical models are presented for utilization in evaluating performance degradation of a ground satellite communications terminal in an interference environment. The model concepts are developed about a generalized functional system incorporating features such as multichannel frequency-division-multiples; a dual-loop phase-lock FM demodulator; and monopulse techniques to provide satellite angular tracking. The models consist of equations, curves, and method techniques. The models cover performance degradation in acquisition frequency search, probability of beacon acquisition, angular search volume, loss of phase-lock, increased graceful degradation, rms angle error, and frequency track loss. Degradation criteria are established to facilitate the application of the models. Interference signals must meet certain criteria to cause degradation in the acquisition sequence, break phase-lock, break frequency track, and effect the angular tracking resolution of the satellite. The mathematical models and criteria, while primarily established to evaluate the degree of system susceptibility, also illustrate the importance of electromagnetic compatibility in design concepts (and specifications planning) during system development. Author

N65-25089 IIT Research Inst., Annapolis, Md. Electromagnetic Compatibility Analysis Center

EFFECTIVENESS OF SPECTRUM AND SELECTIVITY CONTROL IN REDUCING MUTUAL INTERFERENCE IN A TYPICAL RADAR ENVIRONMENT

L. Katz and R. D. Parlow *In it* Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 255–275 refs (See N65-25075 14-07)

A study was conducted employing analytical models and high speed computers to determine the effectiveness of control of these parameters in reducing mutual interference in a typical radar environment. The interference was predicted for an existing receiver tuned throughout its tuning band for several samples of an operating environment in southern California. The validity of the interference predictions had been established. The radiated spectrums of the equipments in the environment were then modified to reflect the addition of available filtering and pulse shaping techniques to attain modulation bandwidth reduction and the interference levels recomputed. Interference levels experienced by a receiver with sharper selectivity skirts were also determined. Interference accompanying the combination of these conditions and also a theoretically obtainable narrower spectrum were determined, and the relative effectiveness of each of the modifications presented. Author

N65-25090 Rome Air Development Center, Griffiss AFB, N. Y.

A METHOD FOR TRANSMITTING RADAR AZIMUTH DATA FOR ANTENNA PATTERN RECORDING

J. F. Spina and J. L. Elberson *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 276–284 (See N65-25075 14-07)

A new technique to be used in conjunction with the recording of transmitted radar antenna patterns, when the radars are operating under normal conditions is described. Heretofore, active antenna pattern data has been of marginal quality because of a lack of accurate antenna azimuth data and inadequate recorder response time, when recording at relatively high antenna rotational speeds. This technique is based upon the idea of combining the high-writing speed capabilities of an oscillograph with the transmission of azimuth data from the test radar to the recording site. The system transmits the azimuth data via a uhf link and may be employed for antenna rotational speeds of 0 to 30 rpm. Azimuth data is transmitted, received, and recorded in 1 degree increments. When these azimuth markers are recorded simultaneously with the antenna pattern, one obtains an accurate indication of antenna angular position. Author

N65-25091 Illinois Univ., Urbana.

FIELD STRENGTH MEASUREMENTS IN A MULTIPATH FIELD USING LINEAR AND CIRCULAR PROBING

R. Mittra and C. O. Stearns (Natl. Bur. of Stds., Wash., D. C.) *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 285–317 refs (See N65-25075 14-07)
(Contract AF 30(602)-2936)

Techniques for resolving the components of a multipath field are investigated. Both linear and circular probing schemes are discussed. Two methods for analyzing the linearly probed data are given, which are considerably simpler than the procedure followed by Watterson. One of these is extended to the circular case. It is found that the resolution in the circular case is substantially poorer than for the linear scheme. Author

N65-25092 General Electric Co., King of Prussia, Pa. Spacecraft Dept.
BROADBAND SUSCEPTIBILITY TESTING
E. S. Warchaizer *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 318–340 refs (See N65-25075 14-07)

A study was made of the feasibility of the use of high powered impulse generators for the performance of broadband susceptibility testing of electronic components. Three different types of coupling networks were employed. The first utilized a standard Line Impedance Stabilization Network of the type specified in MIL-I-26600. The second was the Stoddart Model 91550-1 Current Probe, and the last utilized various types (construction and value) of capacitive coupling. The frequency range investigated was limited to from 15 kc to 25 Mc. Results were obtained using a 90 X 1/18 electronic multiplexer and a pulse position demodulator as the electronic devices. Data will be presented to substantiate the conclusion that the test technique, while needing refinement, is a feasible method of comparing broadband interference levels present to component broadband susceptibility threshold levels. Author

N65-25093 Naval Civil Engineering Lab., Port Hueneme, Calif.
NAVY FIELD STRENGTH METER MEASUREMENTS IN A QUASI-ABSOLUTE MONOPOLE FIELD
D. B. Clark, H. A. Lasitter, and R. D. Hitchcock *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 341–398 refs (See N65-25075 14-07)

A monopole monitored by a current probe in its base was used to calculate cw electromagnetic fields. Most measurements were within the near field; one broadband using an impulse noise source was made. Test frequencies from 0.016 to 86.0 mc were used and readings were taken at 25-foot intervals from 25 to 200 feet. The two meters used with rod antennas flush with the ground usually gave within a ±1.5-dB measurement and calibration error of each other and the calculated field. When the rod antennas were raised 1 meter from the ground, readings were generally 5 to 6 dB higher. Calibrations made with standard loop antennas on EMI meters showed no variation between mountings above and on the ground. Error from the interaction between source and receiving monopoles was insignificant at all distances and frequencies measured during these tests. Curves for the magnetic fields and for the electric fields of the test monopole over the semiconducting infinite plane are derived and presented. M.W.R.

N65-25094 Boeing Co., Renton, Wash.
THE ELECTROMAGNETIC ENVIRONMENT OF TRANSPORT AIRPLANES
L. Jorgensen, R. Goldman, and R. B. Schulz *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 399–420 refs (See N65-25075 14-07)

The electromagnetic environment for transport airplanes is discussed. A typical composite environment, useful as a first-order input for design analysis, is extrapolated from the results of numerous electrointerference tests conducted over a period of many years. Author

N65-25095 General Dynamics/Astronautics, San Diego, Calif. Electromagnetic Compatibility Group
GRAPHICAL PRESENTATION OF ELECTROMAGNETIC SHIELDING THEORY
W. S. Adams *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 421–449 refs (See N65-25075 14-07)

A digital computer was utilized to evaluate the general transmission line form of the shielding effectiveness equations for both high- and low-impedance sources. Results, not limited to either near- or far-field conditions, are presented in simple normalized graphs. Properties of common shielding materials are discussed, and significant data expressed in a compatible graph. This establishes a graphical technique enabling rapid, comprehensive analysis or synthesis of numerous practical shielding configurations involving solid metallic sheets. The significance of specific design parameters is vividly portrayed. Though applicable from 1 cps to infrared, this presentation is useful for problems involving low-impedance (magnetic) radiation. It also provides a sound framework for expressing laboratory data in a more meaningful, applicable form. Material properties (including variations with field intensity and frequency) and application limitations are summarily discussed. Selected configurations are analyzed to illustrate application to typical problems encountered in practice. Author

N65-25096# Ling-Temco-Vought, Inc., Dallas, Tex. Aerosystems Div.
A SPECIAL RESEARCH PAPER ON ELECTRICAL PROPERTIES OF A FLAT THIN CONDUCTIVE STRAP FOR ELECTRICAL BONDING
R. J. Troup and W. C. Grubbs *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 450–474 (See N65-25075 14-07)

The results are presented of mathematical and test investigations performed on a flat beryllium-copper bond strap, with a length-to-width ratio of five to one, to determine its electrical impedance characteristics. The problem of obtaining electrical bonds is discussed; and a popular solution is presented for the calculation of conductor impedances, along with normalized nomographs for quickly determining the impedance, as a function of frequency and various length to width ratios. Author

N65-25098 Rome Air Development Center, Griffiss AFB, N. Y.
INTERFERENCE REDUCTION TECHNIQUES FOR UHF COMMUNICATIONS RECEIVERS
R. Powers, J. Waitkeneus, R. Sugarman, M. Sonstein, L. Tuttle (Am. Electron. Labs. Inc., Colmar, Pa.) et al. *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 496–519 (See N65-25075 14-07)

Several recently developed devices are described which significantly reduce the effects of high level interference signals on communications receivers operating in the 200 to 400 Mc range. These devices include (1) a tunable quarter-wave-coupled band rejection filter which provides over 100dB of signal rejection with a passband insertion loss of 1 to 2dB; (2) a tunable radiofrequency interference rejector, which by means of amplitude and phase adjustments cancels out nearby high level

interference signals in a fixed site receiver antenna system; and (3) a high performance local oscillator and mixer circuit, and a wide range AGC, if amplifier having low intermodulation distortion products. Author

N65-25099 Radio Corp. of America, New York. Systems Lab.
INTERMODULATION DISTORTION IN MIXERS
Bernard B. Bossard, Peter Torrione, and Shui Yuan *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 520–537 (See N65-25075 14-07)
(Contract DA-36-039-AMC-02345(E))

The theory relates the relative intermodulation distortion in positive resistive mixers to the diode parameters and the mixer's operating conditions, and predicts the relative intermodulation distortion caused by diode nonlinearity and gain saturation characteristics. The theory also shows that the intermodulation ratio can be reduced by increasing the local oscillator power. As a result of this theory, the intermodulation distortion of a conventional X-band mixer has been reduced by 50 dB without deteriorating the noise figure and other circuit parameters. All results were verified experimentally under various operating conditions. A brief description of the test setup and experimental results is presented. Author

N65-25100 Rome Air Development Center, Griffiss AFB, N. Y. Vulnerability Reduction Branch
A TRAVELING-WAVE MIXER FOR REDUCED RECEIVER SUSCEPTIBILITY
W. W. Everett, Jr. *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 538–562 refs (See N65-25075 14-07)

Analyses of crystal rectifier mixers used in microwave receivers have assumed a power transfer characteristic of exponential form to simplify computations, but with a limiting approximation. Microwave linear-beam devices utilized in the saturation regime of operation as signal mixers are examined because a portion of the power transfer characteristic is linear; and experimental work directed toward achieving a transfer characteristic with a linear portion extending over a wide dynamic range is described. A medium-power traveling-wave amplifier was modified to accept double-helical-input-couplings, and a transfer characteristic with a linear portion exceeding 60 dB in dynamic range was achieved at S-band while a 50 dB dynamic range was achieved at C-band. Author

N65-25101 General Electric Co., Syracuse, N. Y. Electronics Lab.
INTERFERENCE REDUCTION TECHNIQUES FOR NONLINEAR CIRCUITS
J. C. Otto *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility, [1964] p 563–577 ref (See N65-25075 14-07)
(Contract DA-36-039-AMC-02278(E))

A program directed at reducing interference in low level modulators and multipliers was completed. Five circuits were investigated analytically, by simulation, and by breadboarding. The circuits include the ring modulator, the parametric modulator, the transistor phase modulator, the varactor multiplier, and the feedback modulator. A general discussion of predistortion and feedback, as techniques for interference reduction, is presented along with experimental results of the application of predistortion to the parametric modulator, and the application of feedback to the transistor phase modulator. Author

N65-25102 Army Electronics Labs., Fort Monmouth, N. J.
ANTENNA MODEL FOR RFI WORK
William A. Stirrat *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 578–591 refs (See N65-25075 14-07)
(Contract DA-36-039-AMC-02308(E))

In both theoretical and experimental work, there is a need for a simple antenna model that can be applied at any frequency where its conductor cross section can be neglected (except in the determination of self impedance). Equations are developed for the fields produced by a standing wave of current on a straight conductor. It is shown that if this conductor is connected to another straight section (as at the corner of a loop), or is open at one end (as at the tip of a dipole) with the other end driven or connected to another straight conductor the net result is simple. Two point sources exist, one at each end of the conductor. The field of each source is everywhere the radiation field of that source. The result is discussed as a tool in studies of shielding effectiveness, the susceptibility of circuits to fields, and low frequency field measurements. Author

N65-25103 Atlantic Research Corp., Alexandria, Va.
THE EFFECTS OF SITES UPON THE RADIATION CHARACTERISTICS OF ANTENNAS
W. G. Duff and K. G. Heisler *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 592–609
(Contract AF 30(602)-3118)

The basic model for antennas is presented. The effects of sites upon the model are explored. Parameters such as general antenna type (i.e., horn, parabolic reflector, etc.), specific antenna type (i.e., nomenclature), specific antenna (i.e., serial number), frequency, and polarization are examined to determine their effect on the combined antenna and site radiation characteristics. A practical interference analysis method for representing the apparent radiation characteristics for the combined antenna and site is presented. Author

N65-25104 Michigan Univ., Ann Arbor. Dept. of Electrical Engineering
INTERSYSTEM INTERFERENCE COUPLING LEVELS OF ANTENNAS ON AEROSPACE VEHICLES
J. A. M. Lyon, R. M. Kalafus, and R. B. Harris *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 610–636 refs (See N65-25075 14-07)
(Contract AF 33(615)-1761)

The results are described of analysis and measurement of antenna coupling factors. The objective is to supply information essential to predict the interference between one communication system and another. The results are useful in calculation of interference with each system being part of the same aerospace vehicle with the antennas mounted in a common surface. Data are presented for the coupling between rectangular slots, Archimedean spirals, and several horns. All of the antennas covered are flush mounted types. Simplified computational methods are presented for the couplings of some antennas, along with suggestions for reducing coupling by proper orientation. Modifications necessary to predict coupling for antennas mounted on curved surfaces are indicated. Author

N65-25105 Singer Co., Bridgeport, Conn. Metrics Div.
THE BROADBANDING OF EMC ANTENNAS IN THE 20 TO 200 Mc/s RANGE

M. Epstein and L. Chen *In* IIT Res. Inst. Proc of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 637–652 refs (See N65-25075 14-07)

The construction and performance of two fixed tuned dipole antennas covering the frequency range 20 to 65 Mc/sec and 65 to 200 Mc/sec are discussed. The performance of these antennas is compared with the resonant dipole which is currently being used in EMC measuring equipment. Author

N65-25106 Genistron, Inc., College Park, Md.
A COMPUTER STUDY OF THE INSERTION LOSS OF EMI FILTERS IN MISMATCHED SYSTEMS
J. C. Shifman and R. B. Cowdell *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 653–667 refs (See N65-25075 14-07)

A simple graphical method is presented for determining the insertion loss of electromagnetic interference (EMI) filters in systems having mismatched source and load impedances. Conversely, the element values required to produce a desired amount of insertion loss at a given frequency can be obtained. General equations are presented for the insertion loss of one, two, and three element filters in mismatched systems. Expressions for cutoff frequency and damping ratio are developed. Design nomographs and charts, based on the results of a computer study of the equations, are presented for the case of the pi circuit. Instructions for the use of the charts are provided, and typical examples are studied. Author

N65-25107 Georgia Inst. of Tech., Atlanta.
DEVELOPMENT OF UHF FILTERS WITH LOW SPURIOUS RESPONSE LEVELS
W. B. Warren, Jr. and W. E. Woodward (RADC) *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 668–688 ref (See N65-25075 14-07)
(Contract AF 30(602)-3282)

The development of uhf low-pass and band-pass filters with high rejection of spurious responses at frequencies outside the desired pass-band is described. Spurious response rejection is obtained by the use of a lossy transmission line which exhibits a low-pass characteristic. The lossy line is constructed by using a microwave absorbing material suspended in an epoxy as the dielectric in the transmission line. Data illustrating the variation of attenuation slope and VSWR of these lossy filters with frequency are given. Applications to both high and low power filters are considered. Author

N65-25108 Stanford Research Inst., Menlo Park, Calif.
A METHOD FOR THE DESIGN OF NON-REFLECTING HIGH-POWER MICROWAVE BAND-PASS FILTERS
E. G. Cristal *In its* Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 689–708 refs (See N65-25075 14-07)
(Contract AF 30(602)-3174)

A method for designing nonreflecting, high-power, narrow-band band-pass microwave filters is presented. Filters of this type have in practice very small reflections in the stop band as well as the pass band. A trial filter was synthesized and tested over a very wide band of frequencies. Experimental results compared well with the theory. A very wide stop band with very low reflection was realized. Author

N65-25112 Rome Air Development Center, Griffiss AFB, N. Y.
A NEW GUIDE TO THE CONTROL OF ELECTROMAGNETIC INTERFERENCE IN MILITARY EQUIPMENT
R. Powers and F. Moore *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 814–825 refs (See N65-25075 14-07)

The new standard was introduced into the military specification applicable lists. It was published to establish uniform, updated test methods which will insure interference control designs to be incorporated into new equipment. The MIL-STD-826 was organized to allow flexibility in future updating and to allow excerpts to be extracted for use in reports. There are new requirements as well as relaxations of limits in this standard. It is stated that correct interpretation and use of this standard will increase the efficiency and effectiveness of contractors' interference control programs. Author

N65-25113 General Electric Co., Lynchburg, Va. Communication Products Dept.
IEEE STANDARDS TO ADVANCE RECEIVER INTERFERENCE PREDICTION
N. H. Shepherd *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 826–847 (See N65-25075 14-07)

The two-signal method as a means of measuring receiver selectivity was an important advancement in the measurement of receiver susceptibility. However, certain shortcomings are evident when data taken by this method are used for interference prediction. Proposed changes to the two-signal selectivity method will improve its usefulness for interference prediction by eliminating modulation from the interfering signal and refining the method of data presentation. Data presentation has been reduced to an empirical equation, containing only four constants, which can readily be programed for predicting single-source interference. Author

N65-25140 Lockheed Missiles and Space Co., Palo Alto, Calif. Electronic Sciences Lab.
WAVE PROPAGATION IN RANDOMLY INHOMOGENEOUS MEDIA
G. C. Knollman and J. J. Hartog *In its* Progr. Rept., Jan.–Mar. 1965 [1965] 7 p refs (See N65-25125 14-34)

Mean-square amplitude and phase fluctuations and the correlation coefficient between amplitude and phase fluctuations were derived for the general circumstances of both plane and spherical waves propagating in a random medium with spheroidal inhomogeneities. Normalized mean-square amplitude fluctuations were found to increase while the corresponding phase fluctuations decrease monotonically with increasing transmitter-to-receiver range, for both plane and spherical waves of a given frequency. At a specified range, lower frequencies increase amplitude fluctuations while decreasing phase fluctuations for a medium with spherical or oblate spheroidal patches of inhomogeneity. The opposite tendency is evidenced in a propagation medium containing prolate spheroidal inhomogeneities. For spherical or oblate spheroidal irregularities, plane waves lead to larger mean-square amplitude fluctuations and smaller mean-square phase variations than do spherical waves. The reverse situation appears to apply to prolate spheroidal inhomogeneities. E.E.B.

N65-25197# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
AN INTEGRATED ANTENNA-RADOME
Stephen J. Gotkis 31 Dec. 1964 49 p refs
(Contract AF 33(615)-1081)
(Rept.-1751-8; AD-462327)

A novel integrated antenna-radome is discussed. An electromagnetic window was constructed in a metal wall or radome. It consisted of an array of dipoles connected to an identical array on the opposing face of the radome. This provides high mechanical strength and a transmission device for the electromagnetic radiation. It was found that in order to efficiently transmit over wide scan angles in the azimuth plane the dipole

elements had to be matched to their complex conjugate impedance at a wide angle. Transmission efficiency data is presented as is a prototype model of the dipole feed-through element. Author

N65-25198# AVCO-Everett Research Lab., Everett, Mass.
MICROWAVE BREAKDOWN OF THE AIR AROUND A CONICAL RE-ENTRY VEHICLE
James P. Reilly Apr. 1965 57 p refs
(Contract AF 04(694)-414)
(AVCO-Everett Res. Rept.-214; BSD-TR-65-157; AD-462100)

An investigation is made of electrical breakdown in the path of a beam of microwave energy radiated from conical vehicles during reentry into the earth's atmosphere. Nonequilibrium ionizing boundary layer calculations for these vehicles are reviewed, and included in the analysis, as are the shock layer and free stream. The gas kinetic properties required for the breakdown analysis are identified, and values obtained from gas discharge experiments. These properties as well as the effects of antenna pattern are included in an average electron breakdown calculation of the free stream, shock layer, and ionizing boundary layer of cones with 5°, 10°, and 15° half angles for microwave frequencies of 10^9 and 10^{10} cps. The results indicate that at the highest altitudes, it is the shock layer which is most susceptible to microwave breakdown, while at lower altitudes it is the free stream and boundary layer which becomes critical. At the lowest altitudes, the boundary layer can cause severe signal degradation simply due to the ionization levels present and independent of radiated energy effects. Author

N65-25200# Army Missile Command, Huntsville, Ala. Electromagnetics Lab.
L-B CLUTTER MEASUREMENTS
E. M. Holliday, W. E. Wood, D. E. Powell, and C. E. Basham
3 Nov. 1964 35 p refs
(RE-TR-65-1; AD-461590)

This report reflects procedures, methods, results, and observations of an L-band clutter measurement test activity. A clutter map developed shows primarily the effects of radar masking or shadowing resulting from mountains and the magnitude of clutter experienced from the terrain encountered. The radar cross section per unit area illuminated, σ_o, ranged in value from −61 to +4 decibels, depending upon the reflecting objects. Variations in clutter were observed from day to day and even from hour to hour with the least amount of variation being associated with the mountainous terrain. To develop a composite clutter map, it was concluded that a more automated method should be used as opposed to an azimuth cut or step method used in this activity. Such a method may be the use of PPI photographs where step attenuation would be introduced in the IF amplifier between each photograph. Author

N65-25214# Navy Electronics Lab., San Diego, Calif.
PREDESIGN OF A HIGH-POWER HF TRANSMITTING MULTICOUPLER SYSTEM FOR SOUTHERN CROSS
S. E. Parker 30 Mar. 1965 51 p refs
(NEL-1279; AD-462069)

Design criteria were established for development of an improved hf transmitting multicoupler system under Project Southern Cross for Naval Ships Advanced Communications System. Such a system was designed for the Numbered Fleet Flagship; it utilizes a series of multimesh coupling networks directly combined with the final amplifier stages. Predesign studies indicate that the proposed approach will provide a high order of stability, flexibility, and speed of operations. Author

N65-25220# Bell Helicopter Co., Fort Worth, Tex.
ROTOR BLADE RADAR ANTENNA, PHASE II Interim Technical Report
James E. Palmer and David W. Young (Young (D. W.) and Associates, Inc.) Feb. 1965 68 p refs
(Contract Nonr-4148(00))
(ITR-299-099-275; AD-462744)

This report covers investigation of the feasibility of using the main rotor blade of a helicopter as a high resolution radar antenna. The purpose was to refine a previous design. Fifteen-inch antenna sections were built and tested to study detailed leading and trailing-edge array element environments. A full length, 173-inch array was built and tested. A jig was constructed to accept the full length array, and radiation pattern measurements made of beamwidth, focus, sidelobe levels, and front-to-back ratios. Beamwidth and sidelobes were measured under deflections simulating maximum flight loads. Photographs of thin radar sector slices emphasizing elevation and azimuth obstacle sensing capabilities taken from a modified PPI were compared with optical photographs. The array was then installed, covered with an erosion boot and tested in the leading edge of a used UH-1B rotor blade. Author

N65-25223# California Univ., Berkeley. Electronics Research Lab.
ON THE POSSIBILITIES OF DETECTION OF PERIODIC DISTURBANCES ON A ROUGH SURFACE USING RADIO TECHNIQUES
R. H. Clarke 29 May 1964 41 p refs
(Contract Nonr-3656(11); Grant AF-AFOSR-139-63)
(Rept.-64-21; AD-448493)

The theory of reflection of electromagnetic waves from a moving sinusoidal disturbance, on both rough and still water, is presented in a simple approximate form. It is shown that the detection of such a disturbance is, in principle, a practical possibility. Some of the requirements of such a detection system are briefly discussed. The basis of the simplified theory is discussed in detail, and new experimental results are presented to demonstrate the validity of the approach used. Author

N65-25241# Data Corp., Dayton, Ohio. Systems Engineering Dept.
[DEVELOPMENT OF INFRARED AND PHOTOGRAPHIC TARGETS] Research Status Report No. 6, 1–31 Dec. 1964
William L. Huck 14 Jan. 1965 14 p
(Contract AF 33(615)-1433)
(MPR-65-3)

Progress is reported on the development of infrared and photographic targets for a test range. Radar corner reflector target fabrication is on schedule. A radiometer evaluation program was initiated, and a computer data reduction program was written for handling its output. Surface finish specifications for the radar reflectors are listed. A survey map of the radar target array is included. Also included is a rewritten work statement which reflects engineering advances made during the range construction. R.N.A.

N65-25277# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
SIDELOBE REDUCTION OF MODULATED SURFACE WAVE STRUCTURES
D. J. Cermignani Oct. 1964 15 p refs Publ. in IEEE Trans. on Antennas and Propagation, v. AP-12, no. 4, Jul. 1964
(RM-245J)

An aperture phase distribution perturbation method is applied to the design of modulated surface wave antennas

with controlled sidelobe level reduction. The method consists of producing a sinusoidal perturbation to the phase velocity of a surface wave in a uniform end-fire structure which results in a modulated-surface wave antenna. The modulation frequency is proportional to the azimuthal position of the sidelobe to be reduced in the far field pattern of the unperturbed antenna, and the modulation amplitude is directly proportional to the amount of reduction desired. R.N.A.

N65-25328# Aerospace Corp., El Segundo, Calif. Electronics Div.
ELECTROMAGNETIC COMPATIBILITY REQUIREMENTS FOR SPACE SYSTEMS, GENERAL SPECIFICATION FOR
E. B. Arrowsmith Apr. 1965 110 p refs
(Contract AF 04(695)-469)
(TDR-469(5540-20)-2; SSD-TR-65; AD-463707)

Various electromagnetic compatibility (EMC) control and test plans specified are presented. Design and test requirements are included, from the composite system level down to the individual equipment level, including electroexplosive devices (EED). Author

N65-25343 Bendix Corp., Teterboro, N. J. Eclipse-Pioneer Div.
ANALOG COMPUTER STUDY OF CATEGORY III ILS AIRBORNE AND GROUND EQUIPMENT STANDARDS, PHASE IV Final Report
K. Moses and W. A. Platt Sep. 1964 65 p refs
(Contract FAA-ARDS-451)
(RD-65-61; SD-136)

This report contains results of analog computer automatic ILS approach studies which determined allowable centering and beam width tolerances of the localizer and glide slope transmitters and airborne receivers and indicators, allowable automatic approach coupler tolerances and wind shear performance, and allowable radio altimeter and flare computer errors. Author

N65-25389# Illinois Univ., Urbana. Electrical Engineering Research Lab.
RESEARCH STUDIES ON PROBLEMS RELATED TO ANTENNAS Quarterly Progress Report 1 Sep.–30 Nov. 1964
James Rippin Mar. 1965 70 p refs
(Contract AF 33(657)-10474)
(QR-9; AD-613044)

Progress is reported on various antenna and antenna logarithmic and multiarm logarithmic spiral antennas; an integral antenna amplifier, wave propagation along helical conductors; investigations of periodic and log-periodic structures; radiation lens illuminated from a Goubau waveguide; radiation from circular waveguides; omnidirectional and steerable beam antenna development at millimeter wavelengths; and millimeter antenna test instrumentation and components. R.N.A.

N65-25390# Illinois Univ., Urbana. Electrical Engineering Research Lab.
RESEARCH STUDIES ON PROBLEMS RELATED TO ANTENNAS Quarterly Progress Report 1 Dec. 1964–28 Feb. 1965
James Rippin Mar. 1965 56 p refs
(Contract AF 33(657)-10474)
(QPR-10; AD-613039)

The following topics are discussed: *Radiation from Periodic Structures; Log-Periodic Cavity-Backed Slot Antennas; Log-Periodic Magnetic Current Antennas; Log-Periodic Zigzag Antennas; Multi-Arm Logarithmic Spiral Antennas; An Integrated Antenna Amplifier; Wave Propagation Helical Conductors; Investigation of Periodic Structures; Investigation of a Class of Log-Periodic Structures; Radiation Lens Illuminated from a Goubau Beam-Waveguide; Omnidirectional and Steerable Beam Antenna Development at Millimeter Wavelengths; Millimeter Antenna Test Instrumentation;* and *Components for Millimeter Wave Antennas.* G.G.

N65-25395# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RADIO PHYSICS Quarterly Progress Report, Division 3, 1 Nov. 1964–31 Jan. 1965
J. W. Meyer and M. A. Herlin 12 Mar. 1965 14 p refs
(Contract AF 19(628)-500)
(ESD-TDR-65-50; AD-612773)

The Millstone radar tracked 18 objects, including the IMP-1 Satellite, and obtained returns from stray clumps of the X-band dipoles at L-band. A staggered pulse-repetition rate mode removed ambiguities in the fine Doppler measurements, and a 1000:1 pulse compression mode of the interferometer operation showed a range resolution of 500 feet. Analyses of the 1964 Venus and Mercury observations were completed. It was concluded that the dielectric constant of the surface material on Venus is about 5, and the corresponding value for the Moon is 2.7. Preliminary results of the antenna efficiency, calibration of the antenna pointing, and investigations of radome effects on system performance from radiometric observations are presented. Reliable Haystack antenna operation under control of the pointing computer was limited to short-term intervals. The Millstone system was modified by integration of new timing generators, the digital portion of the digital monopulse was checked out, and a coupling system between the Millstone radar and the Haystack computer was installed. Some solar radar and propagation studies are also briefly discussed. G.G.

N65-25438# Marine Corps Landing Force Development Center, Quantico, Va.
COHERENT VIDEO INTEGRATOR EVALUATION (COVI) Final Report
[1964] 60 p

The Coherent Video Integrator (COVI) was evaluated to determine its suitability for Marine Corps use with Radar Set AN/UPS-1. The COVI moving target indicator does not offer a significant improvement in the performance of Radar Set AN/UPS-1, and is considered unsuitable for Marine Corps use. However, the Video Processor (Correlator) provides an improvement in signal-to-noise ratio and random pulse rejection and will be suitable for Marine Corps use when the deficiencies noted are corrected. Author

N65-25454# Army Electronics Labs., Fort Monmouth, N. J.
MONOCYCLE POSITION MODULATION
William A. Huber [1964] 17 p refs *In* Proc. of the 1964 Army Sci. Conf., Vol. I: Principal Authors "A" Through "H" Conf. held at U. S. Mil. Acad., West Point, N. Y., 17–19 Jun. 1964
(AD-612111)

Described are the basic MPM concepts and how they are applied to encode a binary digital signal stream at the transmitter, and to decode the resulting MPM signal stream at the receiver. Because the MPM system is synchronous and depends on phase identification for decoding at the receiver, a special synchronizing system has been developed. This system has both short time response under dynamic conditions and infinitely long time memory under static conditions. The design and operation of this synchronizing system are discussed. An experimental model of the MPM system operating directly from a binary digital signal stream at 3000 bits/second has been built and the results of operational tests performed in the laboratory on this system are given. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N65-24394# Computer Associates, Inc., Wakefield, Mass.
SOME RESULTS IN THE AREA OF SYNTAX DIRECTED COMPILERS Final Report
Albert L. Dean, Jr. Dec. 1964 103 p
(Contract AF 19(628)-419)
(CA-64-5-R; AFCRL-64-1008; AD-610679)

The Translator Generator System-II is described; this system is composed of a translator called Trangen and a language called Trandir. Trangen is a table-driven compiler whose driving tables consist of representations of the productions which define the language being translated. The Trandir language allows for the definition of the character set, the syntax, the terminal symbols, and the logic required to translate a given high-level language. In addition, the pseudomacros to target machine code may be defined. Author

N65-24408# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering
EVALUATION OF TECHNIQUES AND DEVICES AS APPLIED TO PROBLEM SOLVING Final Report
Morris Rubinoff, J. F. White, Jr., David Loev, and Donald F. Blumberg Griffiss AFB, N.Y., RADC, Feb. 1965 110 p refs
(Contract AF 30(602)-3065)
(RADC-TDR-64-402; AD-614228)

The problem of forecasting technological change is investigated. Machines and computer programs having "problem solving" capabilities are examined to determine their usefulness in aiding or replacing the human forecaster. The literature on human problem solving was also reviewed. The following conclusions were reached: (1) The nature of the forecasting problem precludes the use of computer-type problem solvers developed to date. (2) The application of information science techniques—descriptors representing technological concepts, the forces acting to change the technology and the laws governing the change—appear to offer the most promise in assisting the human forecaster. Accordingly, a quasi-mathematical model was developed using matrix notation to describe a technology. An example of a forecast of computer technology made several years ago is included. Author

N65-24708# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
CHARGE, A SPACE RADIATION SHIELDING CODE
J. R. Lilley and W. R. Yucker Apr. 1965 114 p refs
(SM-46335)

CHARGE is a Fortran program for analysis of primary proton and electron passage through plane or spherical shields containing up to 100 regions, and the attendant generation and transmission of electron-induced X-rays (bremsstrahlung) and proton-induced secondary protons and neutrons. Proton and electron analyses use a modification of the range–energy relation applied to up to 100 energy groups; the bremsstrahlung transmission calculation assumes exponential attenuation corrected by semiempirical dose buildup factors applied individually to a similar number of gamma-ray energies. Availability of several bremsstrahlung source options permits comparison of most commonly used approximations. Energy-dependent removal cross sections are used to calculate secondary neutron transmission. Ambient charged particle differential spectra may be specified as varying as a power or an exponential of energy over each of several specified energy ranges, in tabulated or functional form. Analysis used is described; results are compared to other calculations and to experiments. Author

N65-24953# Hanford Atomic Products Operation, Richland, Wash. Physics and Instruments Lab.
PROCESS CONTROLLER SIMULATOR FOR FAST ANALOG SIMULATIONS
G. G. Thieme Nov. 1964 25 p
(Contract AT(45-1)-1350)
(HW-82797) CFSTI: $2.00

The design of a self-contained, versatile, process controller simulator capable of a simulation time scale speedup of at least 10 is described. The design consists of plug-in units of proportional-plus-reset, proportional-plus-derivative, and rate limiter units. Error amplifiers, capable of variable gain configurations, are obtained by using resistor plug-in units with spare operational amplifiers. A solid state switch, used to drive the mode control relays of the proportional-plus-reset and rate limiter units, is actuated by analog computer mode–control voltages. Only the initial condition and compute modes are available at the plug-in units but the hold mode can be added if needed. Voltage and power sources are supplied with the controller unit and are permanently installed. Controller interconnections, which are dictated by desired controller configurations, are modified with banana plug leads or terminal board connections. R.N.A.

N65-24973# Argonne National Lab., Ill. Physics Div.
NAMED STORAGE: A DYNAMIC STORAGE-ALLOCATION SCHEME WITH MANIPULATIVE ROUTINES
Stanley Cohen Apr. 1965 37 p
(Contract W-31-109-ENG-38)
(ANL-7021) CFSTI: $2.00

A dynamic storage allocator is described which makes efficient use of the computer storage facilities by adjusting to the size of the problem being treated and altering the allocation of space in the memory to suit the particular phases of the computation. The programing system relies on the concept of named storage which means that all stored data can be referred to by name alone. With this system more information is made available to the subroutines which can then perform tasks normally done by the computational program, thus easing the program writing task. Information input and output are handled by manipulating routines. These manipulators are coordinated with allocators, operate directly on stored information, are controlled by the computational program, and are the means for carrying out computations efficiently. Standard system manipulators and a group of general and matrix manipulators including outlines of their routines are described. The advantages of named storage are discussed. R.N.A.

N65-25010*# National Bureau of Standards, Washington, D.C. Information Technology Div.
MAGIC: A MACHINE FOR AUTOMATIC GRAPHICS INTERFACE TO A COMPUTER
Don E. Rippy 29 Dec. 1964 58 p
(NASA Order R-09-022-039)
(NASA-CR-62897; NBS-8665) CFSTI: HC $3.00/MF $0.50

Described is a machine that combines two large cathode-ray display consoles joined together with a specially designed data processor organized around a magnetic-drum memory that acts as a remote display station in connection with a large automatic data processing system. The magnetic drum memory includes a general memory, consisting of 90 channels of 128 12-bit words each, and a display memory, consisting of 4

channels of 128 12-bit words each that act as display processors. A basic block diagram of MAGIC is shown and the programing and operating procedures are described. G.G.

N65-25054 Joint Publications Research Service, Washington, D. C.
FERRITE MEMORY DEVICE FOR THE JOINT STORAGE OF OPERATIONAL AND LONG-TERM INFORMATION
N. S. Anishin *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 289–297 (See N65-25031 14-10) CFSTI: $8.28

Described is an operational ferrite memory device with linear selection and with only one digit core that combines the operational memory with long-term information storage. The operational memory can be utilized for separate operation through the use of a lesser rejection frequency than the total combined frequency for OMU and permanent storage. This device makes it possible to use either operational or long-term information, and several methods for combination of the operational and long-term information devices are discussed. G.G.

N65-25055 Joint Publications Research Service, Washington, D. C.
DEVELOPMENT OF AN ANALOG MEMORY DEVICE USING A MAGNETOSTRICTIVE DELAY LINE
A. D. Gromova *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 298–309 refs (See N65-25031 14-10) CFSTI: $8.28

A memory unit is considered for analog computers of the dynamic type built using a magnetostrictive delay line (MDL). There exists a method for time-delay of low-frequency voltages on MDL with the aid of amplitude and frequency modulation. For amplitude modulation, the property of the linearity of the input characteristic of the magnetostrictive material is used. The output voltage of the line is proportional to the input current or the level of the low-frequency input signal. For separating the signal at the output, integration is used which rectifies and filters the signal. Author

N65-25143# Joint Publications Research Service, Washington, D. C.
USE OF COMPUTERS FOR MODELLING NEURONS AND THE MEMORY PROCESS
31 May 1965 16 p refs Transl. into ENGLISH from Vychislitel'naya Tekhn. i Vopr. Programmirovaniya (USSR), no. 3, 1964
(JPRS-30346; TT-65-31129) CFSTI: $1.00

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1. MODELLING THE MEMORY PROCESS IN THE SIMPLEST NERVOUS NET ON A COMPUTER R. M. Granovskaya, V. A. Ganzen, and G. Ya. Krivova p 1–5 refs (See N65-25144 14-08)

2. DEVICE FOR COMPUTING AND MODELLING NEURONS V. A. Gazen and R. M. Granovskaya p 6–13 refs (See N65-25145 14-08)

N65-25144 Joint Publications Research Service, Washington, D. C.
MODELLING THE MEMORY PROCESS IN THE SIMPLEST NERVOUS NET ON A COMPUTER
R. M. Granovskaya, V. A. Ganzen, and G. Ya. Krivova *In its* Use of Computers for Modelling Neurons and the Memory Process 1964 p 1–5 refs (See N65-25143 14-08) CFSTI: $1.00

The modelling of the memory function in a network of neurons is examined. The network studied was in the form of a matrix of 24 neurons, each of which had 33 inputs. Each neuron had n + 1 inputs and 1 output. Recording, storage, and recall are covered. E.E.B.

N65-25145 Joint Publications Research Service, Washington, D. C.
DEVICE FOR COMPUTING AND MODELLING NEURONS
V. A. Ganzen and R. M. Granovskaya *In its* Use of Computers for Modelling Neurons and the Memory Process 1964 p 6–13 refs (See N65-25143 14-08) CFSTI: $1.00

A device to study the behavior of neuron models in a wide range of measurements is described. From the design standpoint the type of neuron was determined by the number of inputs into perturbing and retarding signals, and by the constant weights of the inputs. The regime was determined functionally by the sequence of signals at each output, by the set, by the rule for temporal change of threshold values, and by the rule of forgetting. The capacity of the tape permits the investigation of the functioning of the model for 500 cycles. An approximate calculation showed that in the device 10^7 different type regimes can be investigated. E.E.B.

N65-25146# Illinois Univ., Urbana. Dept. of Computer Science
A FAST TRANSLATION TECHNIQUE WHICH PARTIALLY OPTIMIZES THE OBJECT CODE
C. W. Gear 5 Apr. 1965 18 p refs
(Rept.-172)

A three-pass compiler is described. The last two passes scan an intermediate language produced by the preceding pass in essentially the reverse of the order in which it was generated, so that the first pass is the only one which has to read the relatively bulky problem-oriented input. The double scan, one in either direction, performed by the first two passes, allows the compiler to remove locally constant expressions and recursively calculable expressions from loops and to do the important part of common subexpression recognition. Optimization, such as the effective use of index registers, although as important, is not discussed, since the object code which would be most efficient is highly machine dependent. The discussion is in terms of a Fortran-like language, although the technique is applicable to most algebraic languages. Author

N65-25165# United Kingdom Atomic Energy Authority, Harwell (England).
TERMINOLOGY OF PUNCHED-TAPE TECHNIQUES
H. Buntrock (EURATOM) Dec. 1964 89 p refs Transl. into ENGLISH from GERMAN
(AERE-TRANS-1015) HMSO: 12s

This is a five-language glossary of terminology of punched-tape techniques in English, French, German, Italian, and Dutch. Where necessary the terms are defined in English. The terms are arranged both systematically and in alphabetical indexes for each language. An appendix lists functions and nomenclature for tape-typewriter keyboards. Author

N65-25237# Gt. Brit. Ministry of Aviation, Mottingham. Technical Information and Library Services
FLUTED FILMS USED FOR STORAGE DEVICES [MAGNETISCHE STUFENSCHICHTEN ALS SPEICHERELEMENTE]
H. Billing Apr. 1965 10 p refs Transl. into ENGLISH from Elektron. Rechenanlag. (Germany), v. 5, no. 6, 1963 p 257–261
(TIL/T-5532)

In order to write information into a single storage element of a magnetic matrix store by the double coincidence method, without destroying information stored in other elements of the matrix, the magnetic field required for writing information must be composed of two partial fields which produce no irreversible change in magnetization. The development of

storage elements which satisfy this condition is discussed. The stable fixing of the magnetization in one or the opposite hard direction was employed, and the geometrical form of the films was modified to give stable equilibrium films for fixing the magnetization in the two hard directions. Experiments with a single fluted film with a differential frequency of 30 Mc/sec showed that reading amplitudes of 1 and 0 differ by a factor of 160. With fluted films of 2-mm diameter, the maximum amplitude of 150 V was higher than the noise level of the measuring amplifier which was 0.3 V. A special advantage of thin magnetic film is that its frequency limit is higher than that of the ferrite core. E.E.B.

N65-25354 RCA Institutes, Inc., New York.
LOGICAL DESIGN FOR DIGITAL SYSTEMS
Alfred B. Peticolas and Matthew V. Mahoney 1964 192 p refs

Number Systems and Basic Logic; Boolean Algebra and the Introduction to Logic Design; Logic Dependence, Matrix Equations, and Logic; Logical Design of Computer Elements; and *Applications of Logic Elements to Computer Systems* are covered in detail. Because the theme of the seminar for which this material was written was design, emphasis was placed on direct, powerful solutions to common design problems. Design procedures enumerated were tested in actual application, and every circuit shown has been verified by actual construction. E.E.B.

N65-25396# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHODS OF PREPARATION OF INFORMATION FOR MACHINE TOOLS WITH PROGRAMMED CONTROL Selected Articles
5 Mar. 1965 39 p refs Transl. into ENGLISH of a publ. Metody Podgotovki Inform. Dlya Stankov s Programmnym Upravleniyam (USSR), 1963 p 86-100, 148-161
(FTD-TT-65-149/1+2); AD-612616)

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1. READYING PROCESSING PROGRAMS FOR MACHINES WITH PROGRAM CONTROL USING ELECTRONIC COMPUTERS V. I. Skurikhin and V. G. Tyupa p 1-18

2. ABOUT DYNAMIC ERRORS AND THEIR CORRECTIONS AT PROGRAMMED MACHINE CONTROL K. V. Lepik p 19-36 refs

N65-25410*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station
DEVELOPMENT OF NEW METHODS AND APPLICATIONS OF ANALOG COMPUTATION. I: AN EXPERIMENTAL ELECTRONIC GENERALIZED INTEGRATOR. II: NONSTATIONARY NOISE FOR MONTE CARLO STUDIES Quarterly Program Report, 12 Sep.-12 Dec. 1961
R. S. Johnson, F. R. Williamson, and R. D. Loftin 12 Jan. 1962 30 p refs
(Contract NAS8-2473)
(NASA-CR-63191; GIT/EES-A588/P1)

Progress is reported on the investigation of electronic techniques for integrating analog voltage signals with respect to arbitrary variables which include the construction of a general integrator compatible with existing analog equipment; and the investigation of analog techniques for the generation of nonstationary noise voltages to be used in analog Monto Carlo studies. The integrator design was completed and circuit construction initiated. The sampling gate circuit breadboard was built and evaluated. The analysis of certain specific stochastic processes, the selection of statistical functionals for specifying nonstationary noise, and an investigation of linear networks for nonstationary shaping are discussed. R.N.A.

N65-25451*# National Aeronautics and Space Administration, Goddard Inst. for Space Studies, New York
SUPERSPEED COMPUTERS: A MAJOR TOOL IN THE SPACE SCIENCES
Robert Jastrow and Albert Arking 22 Apr. 1965 11 p Submitted for Publication
(NASA-TM-X-56433) CFSTI: HC $1.00/MF $0.50

The prospect of using the computer as a laboratory for the performance of experiments is discussed. Knowing the laws of the physical sciences and programing these data into the computer allows the machine to be used as a laboratory for the solution of any physical problem for which basic data have been put into the machine. This can be done in a fraction of the time it would take to perform the calculation by other means, if indeed, it could be solved at all. Application to weather calculations, the solar system, and to nuclear study is given as illustrative of the types of experiments which can be done. E.E.B.

N65-25481# United Kingdom Atomic Energy Authority, Risley (England).
DISCOUNT D—AN IMPROVED VERSION OF THE COMPUTER PROGRAM FOR ECONOMIC ASSESSMENT OF NUCLEAR POWER SYSTEMS
G. Black 1965 26 p
(TRG-894(R)) HMSO: 3s

A computer program for IBM 7090 in Fortran II language is described which calculates, among other things, the discounted unit cost of electricity sent out from a wide range of national nuclear power programs. The computer program represents an extension, with modifications, of a program for the Ferranti Mercury computer, described in a previous report. In the IBM 7090 version there are twice as many reactor types as in the previous work, and the new program makes possible more detailed study of the effect, on discounted unit cost of electricity sent out, of the inclusion of varying proportions of nuclear to total generating capacity. The costing of conventional power stations is incorporated. Details of the computer calculation and the way in which the program works are reported. Major differences between the Mercury and IBM 7090 programs are pointed out. Author

N65-25482# United Kingdom Atomic Energy Authority, Risley (England).
DEMON—A COMPUTER PROGRAM WHICH SOLVES CERTAIN TIME-DEPENDENT EQUATIONS DESCRIBING THE DIFFUSION OF HEAT WITHIN A NUCLEAR REACTOR
C. W. J. Mc Callien 1965 36 p refs
(TRG-848(R)) HMSO: 5s

DEMON is a Fortran II program for the IBM 7090 computer. It is designed to study the temperatures which would occur in a magnox reactor, such as those at Calder Hall, if the magnox in one of the fuel channels were to ignite as the result of a fault condition and were to burn in the cabon dioxide coolant. A three-dimensional model of several adjacent square cells in the reactor core is built up in the computer. The transfer of heat in the vertical direction by the coolant and the horizontal diffusion of heat are both considered. The release of Wigner energy as the moderator temperature rises is taken into account. The equations solved are stated, the method of solution by finite differences is discussed, and the data requirements of the program are given. Author

N65-25484# United Kingdom Atomic Energy Authority, Risley (England).
A REVIEW OF COMPUTER PROGRAMMES FOR SOLVENT EXTRACTION CALCULATIONS

A. L. Mills 1965 14 p refs
(TRG-902(D)) HMSO: 2s

Five digital computer programs for solvent extraction are compared. All the programs use experimentally determined distribution data, and one program is used for the study of dynamics and control of pulse columns. Author

N65-25525# Oak Ridge National Lab., Tenn. Neutron Physics Div.
A GENERALIZED ONE-CONSTRAINT LAGRANGE MULTIPLIER NUMERICAL FORMULATION
F. H. S. Clark and F. B. K. Kam Jun. 1965 47 p
(Contract W-7405-ENG-26)
(ORNL-3742, Rev.) CFSTI: $3.00

The one-constraint LaGrange multiplier problem has been written for the CDC-1604 computer in a Fortran program called MAX. The program can deal with a combination of any varied and any constraining function which depends on no more than 18 independent variables and for which all second derivatives exist throughout the domain. The user is required to write two subroutines: one defining the varied function; the other, the constraining function. The computational method used is absolutely nondivergent, but for some starting values in some problems it will stop in the neighborhood of an extraneous point and require a restart at a different point. A test problem is included. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N65-24391# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
SMALL SIGNAL SEMICONDUCTOR COMPOSITES Final Report, 1 Jul. 1963–30 Jun. 1964
James Feit [1964] 108 p
(Contract DA-36-039-AMC-03212(E))
(AD-614090)

Steps in the design, evaluation and fabrication of linear integrated circuits with performance similar to circuits utilized in manpack communications gear are listed. Four circuits were developed and fabricated: (1) IF amplifier—a low power drain stage capable of 20-dB cascaded power gain at 455 kc; (2) limiter—a low power drain stage with sufficient power output at 455 kc to drive a discriminator; (3) squelch—a low power drain stage with the capability of suppressing audio output by 50 dB, and (4) audio—a circuit with low standby power drain, 50-dB power gain and 100-mW audio output. The demonstration vehicle for these circuits, an interim integrated circuit receiver, was designed utilizing the linear integrated circuits described for the receiver back end. For the rf, mixer and oscillator functions, integrated circuits designed for other applications were adapted. These front end circuits permit demonstration of the receiver, but introduce a very heavy power drain. The receiver was constructed using passive external components where necessary. Author

N65-24405# Army Electronics Labs., Fort Monmouth, N. J. Electronic Parts and Materials Div.
TUNABLE PRESELECTION THROUGH PARAMETRIC CONVERSION
Joseph M. Giannotto and Eugene J. Chabak Nov. 1964 46 p refs
(ECOM-2510; AD-614027)

One of the most damaging deficiencies in present rf receiver design is vulnerability to overloading caused by strong out-of-band signals which can partially or completely disrupt communications. The emergence of the parametric amplifier has provided the design engineer with a frequency converter which is considerably more amplitude-linear than conventional devices, with the added feature of low noise characteristics. The attenuation of strong out-of-band signals is accomplished by the use of a high Q fixed frequency filter following the parametric converter. With this approach a dynamic range of 140 dB has been achieved, an improvement of 55 to 60 dB over well-designed conventional receivers. Comprehensive performance characteristics of a tunable parametric preselector were developed to operate over the frequency range of 2 to 32 megacycles. Also presented is a discussion of the ramifications of selecting the specific circuitry and parts. Author

N65-24407# ARINC Research Corp., Washington, D. C.
SYSTEM RELIABILITY PREDICTION BY FUNCTION
Harold Balaban Griffiss AFB, N. Y., RADC, Mar. 1965 22 p refs
(Contract AF 30(602)-2838)
(RADC-TDR-63-300, Suppl. 1; AD-614227)

A set of revised equations for ground system reliability prediction is presented. The basic approach and data are the same as were used in the original study described in RADC-TDR-63-300. The original equations were revised and simplified. These equations are of the form $\text{Ln } \hat{\theta} = b_o + b_1X_1 + b_2X_2 + \ldots + b_nX_n$ where $\hat{\theta}$ is the predicted system mean life and the X_i are measures of equipment characteristics. The coefficient b_1 was determined by multiple regression analysis. Three prediction equations are presented based on five equipment characteristics. Also included are methods for computing the confidence interval for the estimated mean life. Author

N65-24409# Eitel-McCullough, Inc., San Carlos, Calif.
HIGH POWER X-BAND GENERATOR Quarterly Report No. 9, 1 Oct.–31 Dec. 1964
William R. Luebke and Tore Wessel-Berg 1 Mar. 1965 33 p
(Contract AF 30(602)-2756)
(RADC-TDR-65-96; AD-614001)

The purpose is to develop a klystron amplifier operating at 8 kMc and delivering one megawatt of cw power. The first of the multioutput tubes was tested cw. Waterload arcing hampered the testing, but 500 kW was observed for a brief period, and operation at 350 to 400 kW was reasonably stable. Subsequently the tube was lost when an arc detector failed to fire and a window cracked. Further tube testing could not be accomplished owing to failure of the main high-voltage transformer. Further analysis of power flow in extended-interaction cavities is presented. Author

N65-24427# Fairchild Semiconductor Corp., Palo Alto, Calif. Research and Development Labs.
MICROWAVE SOLID-STATE GENERATORS; X-BAND SOLID-STATE POWER SOURCE Second Quarterly Progress Report, 1 Sep.–30 Nov. 1964
Richard A. Henschke [1964] 45 p refs
(Contract DA-28-043-AMC-00120(E))
(Rept.-2; AD-614047)

A study is made of the circuit requirements for broadband diode doublers and triplers using an analytical approach based on the work of Penfield and Rafuse. Circuit requirements for narrowband and broadband multipliers were established from

the theory, and a logical design procedure was worked out. Corroborative experimental data are provided from results obtained for a 1- to 2-Gc doubler and a 2- to 6-Gc tripler which operate efficiently, on a fixed tuned basis, over bandwidths of at least 4%. Application of these results to the design of multipliers for an X-band source is indicated. A discussion is presented of the problems associated with the construction of an operable driver oscillator using parallel transistors. Preliminary results of multiplier diodes are mentioned. Author

N65-24430# Compagnie Generale de Telegraphie sans Fil, Paris (France).
RESEARCH ON ONE MILLIMETER C.W. CARCINOTRON
Final Report
Dec. 1964 199 p
(Contract AF 61(052)-629)
(WR-1318; RADC-TR-65-154; AD-614459)

Tubes, in depressed collector operation, gave, at these frequencies, an efficiency of the order of 0.6%. A bandwidth of 3% (900 Mc/s) was covered with a power of 500 milliwatts. Author

N65-24543 Joint Publications Research Service, Washington, D. C.
DIODELESS FERRITE UNIT WITH BRIDGE COUPLING
V. A. Popov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 219–226 refs (See N65-24525 14-07) CFSTI: $7.00

Results are given for the investigation of a push–pull diodeless ferrite unit with bridge coupling. The operation of the circuit is considered by using a shift register as an example. Author

N65-24553 Joint Publications Research Service, Washington, D. C.
ON THE THEORY OF SPIN GENERATORS
R. M. Umarkhodzhayev *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 268–274 refs (See N65-25425 14-07) CFSTI: $7.00

A study of several problems inherent in the theory of spin generators is presented. Considered are inertial nonlinearity, the effect of radio circuit parameters on the frequency and amplitude of a spin generator with inertial nonlinearity, the steady state frequency of the spin generator, the steady state frequency of a spin generator generating oscillations with Larmor precession frequency, and the use of pulling the spin generator frequency for tracking the magnitude of the magnetic field. S.C.W.

N65-24557 Joint Publications Research Service, Washington, D. C.
AN EXPERIMENTAL INVESTIGATION OF A TRAVELING-WAVE STROPHOTRON
Yu. G. Al'tshuler, Ye. V. Anisimov, and R. M. Revzin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 294–299 refs (See N65-24525 14-07) CFSTI: $7.00

Results of an experimental investigation of a laboratory model, designed to determine the basic characteristics of a traveling wave strophotron, are presented. It was found that the level of the magnetic field, the voltage on the collector, the filament current, and the length of the interaction space produce little effect on the frequency characteristics of the strophotron, while the dependence has a character close to the linear law. Preliminary results indicate that with respect to the broadband feature and the level of generated power, the traveling wave strophotron is comparable to the ordinary wave tube. Noted among the disadvantages of the device is the necessity for a comparatively strong magnetic field. S.C.W.

N65-24558 Joint Publications Research Service, Washington, D. C.
TUNNEL-DIODE CELLS FOR STORAGE DEVICES WITH NONDESTRUCTIVE READOUT OF INFORMATION
V. V. Kimov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 300–304 refs (See N65-24525 14-07) CFSTI: $7.00

Results of an analysis of the use of tunnel diodes in memory cell circuits of operational storage devices with nondestructive readout of information for reducing access time are presented. Also noted is the possible use of memory cell circuits as controllable generators, and as controllable kipp oscillators. S.C.W.

N65-24636# Royal Aircraft Establishment, Farnborough (England).
THE SWITCHING ACTION OF A TRANSISTORISED SCHMITT-TRIGGER CIRCUIT [DER SCHALTMECHANISMUS DES SCHMITT-TRIGGERS MIT TRANSISTOREN]
K. Leberwurst Feb. 1965 24 p refs Transl. into ENGLISH from Nachrichtentechnik (E. Berlin), v. 10, no. 12, 1960 p 519–524
(RAE-LIB-TRANS-1094)

Expressions are derived for the current–voltage characteristics of a transistorized Schmitt-trigger circuit with the transistors in various states of conduction. Theoretical results are compared with experimental and differences between them explained. An example of the use of a Schmitt-trigger circuit is given. Author

N65-24715# General Electric Co., Pleasanton, Calif. Vallecitos Atomic Lab.
CHARACTERISTICS OF A THERMIONIC CONVERTER WITH A HIGH TEMPERATURE COLLECTOR
E. Blue and J. H. Ingold 15 Jan. 1963 23 p refs
(GEST-2011)

Current–voltage characteristics of a cesium-on-tantalum thermionic converter with a collector temperature comparable to that of the emitter are presented for a variety of electrode temperatures and cesium vapor pressures. Results can be summarized: (1) For emitter temperatures in excess of 2000° K, power outputs of a few watts per square centimeter can be obtained when the ratio of collector temperature to emitter temperature is as high as 0.75 to 0.80, the required range for best performance of a radiation-cooled Carnot engine. (2) At temperature ratios above 0.80, power output is unsensitive to changes in electrode spacing for ratios of spacing to electron mean free path greater than 100 at a cesium vapor pressure of 5 torr. Author

N65-24788# Radio Corp. of America, Camden, N. J. Communications Systems Div.
MICROMODULE PROGRAM EXTENSION II: MICROELEMENT CAPACITORS PRODUCTION ENGINEERING MEASURE
Formal Engineering Report
Jan. 1965 368 p
(Contract DA-36-039-SC-75968)
(AD-610851)

Continued research designed to create a broadbased military production capability for a wide range of microminiature electronic equipment, based on the concept of micromodular construction, is reported. Presented are results of studies on the establishment of a production capability for microelement capacitors of various characteristics to support a micromodule requirement of 25000 per month. Tested were single and multilayer ceramic capacitors, tantalum electrolytic capacitors, and variable ceramic capacitors. Results show that all capacitor component types performed satisfactorily in the micromodule environment. Efforts to develop a low cost, high production metallized substrate wafer resulted in the establishment

of an automated wafer metallizing line. The development of a machine to metallize the land and notch on ceramic wafers is reported. The pilot run of this machine demonstrated a rate of 4000 metallized wafers per 8-hour shift. Production yields in excess of 95% were demonstrated. An analysis of existing processes for the production of the selected capacitor components is also included. S.C.W.

N65-24793# Sylvania Electric Products, Inc., Waltham, Mass.
ACTIVE THIN FILM TECHNIQUES MICROMIN PROGRAM Interim Development Report, 1 Feb.–30 Apr. 1964
Egons Rasmanis, James Cline, and Robert Tiernan, 26 May 1964 47 p
(Contract NObsr-87633)
(IDR-7; AD-601020)

A process is developed for depositing device-quality silicon and/or germanium films on glazed polycrystalline insulating substrates by vacuum evaporation of silicon and/or germanium and to form thin film diodes and transistors in these films. Major changes in the high vacuum evaporation equipment included removal of the chemical baffle and replacement of both the former electron gun and source holder by a compact electron beam evaporation source. The rate of silicon deposition was increased from 2μ to 12μ per hour. Vacuum-deposited silicon insulated gate field effect transistors were fabricated with transconductances in the range 100 to 300. The electrical characteristics of these devices were studied for use in a preamplifier circuit. A number of annealed silicon films were analyzed by X-ray diffraction which show that during annealing of rheotaxial silicon films, the orientation changes from preferred (110) with a minor of (331) to (111) orientation, and these firmly establish the improved crystallographic nature of rheotaxially grown silicon films. Modifications were made in the Hall equipment for low temperature work and improvements were made in metal contacts to the silicon films. Derivation of the equations for PME and photoconductive voltages were presented for calculation of the lifetime of minority carriers by an expression independent of light intensity and of surface recombination velocities. Author

N65-24796# International Business Machines Corp., Owego, N. Y. Space Guidance Center
STUDY OF EFFECT OF HIGH-INTENSITY PULSED NUCLEAR RADIATION ON ELECTRONIC PARTS AND MATERIALS (SCORRE) First Semiannual Progress Report, 15 Jun.–31 Dec. 1964
[1964] 44 p
(Contract DA-28-043-AMC-00212(E))
(IBM-65-521-05; AD-461486)

Radiation testing of ceramic, glass, tantalum, mica, polystyrene, and mylar capacitors is complete. Data analysis is not complete. New effects were observed when testing glass and tantalum capacitors. Leakage currents in irradiated thin-film resistors are principally due to secondary emission and air ionization. No data errors were detected on a magnetic tape that was irradiated. Dosimetry techniques are described, and errors in previous linac dosimetry are discussed. Author

N65-24800# Lenkurt Electric Co., Inc., San Carlos, Calif.
CONVERTER GROUP, SIGNAL DATA OA-7319(XW-1)/FCC-17 AND OA-7423(XW-1)/FCC-17, PHASE A Final Technical Report
Forrest N. Easley and C. Dean Charrier 30 Oct. 1964 39 p refs
(Contract AF 30(635)-11188)
(RADC-TDR-63-506, Vol. 1; AD-461668)

A chronological summary is given of the design and development problems and a detailed theoretical discussion of the Signal Data Converter Group (transmit) and the Signal Data Converter Group (receive) which were designed and developed for insertion in a 4-wire vf (0.3- to 3.5-kc) path for converting telephone dc dialing and supervisory information into in-band 2600-cps tone pulses for transmission over a multiplex carrier and reconversion of the tone pulses back into dc pulses for use by central telephone switching equipment. Some of the major problems found in the transmitter were first-pulse distortion, signal tone leakage, and signal tone distortion. The major problems encountered in the receiver were amplifier gain stability, low-frequency response of the tone amplifier, high-level saturation of the tuned circuits, and false signal indications on the E-lead. Additionally, all circuits had to be temperature compensated to prevent pulse distortion during dialing conditions. The predicted mean-time-between-failure of the Signal Converter Groups (24 channels each) is 320 hours and a point-availability of 99.92 percent. Author

N65-24801# Lenkurt Electric Co., Inc., San Carlos, Calif.
CONVERTER GROUP, SIGNAL DATA OA-7319(XW-1)/FCC-17 AND OA-7423(XW-1)/FCC-17, PHASE B Final Technical Report
Forrest N. Easley and John Congistre 30 Oct. 1964 27 p
(Contract AF 30(635)-11188)
(RADC-TDR-63-506, Vol. 11; AD-461669)

A chronological summary is given of the fabrication and testing of the Converter Group, Signal Data OA-7319(XW-1)/FCC-17 and OA-7423(XW-1)/FCC-17. These signal converter groups were designed and fabricated for insertion in a 4-wire vf (0.3- to 3.5-kc) path. They convert telephone dc dialing and supervisory information into in-band 2600-cps tone pulses for transmission over a multiplex carrier and reconvert the tone pulses back into dc pulses for use by central telephone switching equipment. During environmental testing at −29° C, a solid tantalum capacitor failed due to unlike expansion characteristics of its internal materials. All tantalum capacitors were replaced with an improved-type solid tantalum capacitor with higher voltage ratings than the original tantalum capacitor that failed. Subsequent to the above modification, the two signal converter groups (transmit and receive) operated well within the specified limits of performance. Author

N65-24802# Lenkurt Electric Co., Inc., San Carlos, Calif.
NETWORK GROUP, HYBRID CIRCUIT OA-7424(XW-1)/FCC-17, PHASE A Final Technical Report
Thomas F. Curry and C. Dean Charrier 30 Oct. 1964 23 p refs
(Contract AF 30(635)-11188)
(RADC-TDR-63-529, Vol. I: AD-461670)

A summary is given of design and development problems and a theoretical discussion of the network group, hybrid circuit, which was designed and developed to provide two-wire termination for 12 four-wire voice frequency circuits. Transhybrid balance is accomplished either by strapping-in an internal compromise balancing network or by utilizing an external precision balancing network. Mechanically, the shelf is unique in that it is mounted in an upside-down position with respect to the conventional mounting of AN/FCC-17 shelves. The predicted mean-time-between-failure of two network group, hybrid circuits (24 channels) is 5820 hours with a point availability of 99.995 percent. Author

N65-24803# Lenkurt Electric Co., Inc., San Carlos, Calif.
COMPANDOR CONSISTING OF COMPRESSOR, WAVEFORM, TA-619/FCC-17, & ( ) AND RESTORER, WAVEFORM, TA-620/FCC-17 & ( ), PHASE A Final Technical Report

Forrest N. Easley, C. Dean Charrier, and T. R. Holmes 30 Oct. 1964 77 p refs
(Contract AF 30(635)-11188)
(RADC-TDR-64-370, Vol. I; AD-461671)

The design requirement was for compressor and expandor circuits that could be used with AN/FCC-17 type telephone multiplex equipment. The purpose of the compandor was to reduce apparent noise at the receiving end of a voice circuit without degrading the vf signal. To provide a compandor circuit that would have compression and expansion action at median voice levels, and linear characteristics at data signal levels; a circuit with a focal point of −9 dbmO and a compression–expansion ratio of 3:1 was designed, but efforts to further improve its performance tended to restrict its ability to handle data. Compressor and expandor circuits were redesigned to have a 0-dbmO focal point and a 2:1 compression–expansion ratio. To ensure accurate tracking capability and low signal distortion, a selection procedure was developed for matching the military-approved diodes in the variolosser circuits. Tests proved this compandor circuit capable of meeting design requirements. Compressor and expandor panels each provide 12 channels unidirectional capability and utilize plug-in compressor and expandor modules. Reliability predictions indicate a mean time between failure of over 15 500 hours for a compressor channel, and over 15 200 hours for an expandor channel. The point availability per channel is estimated to be 99.9995% for the compressor and 99.9994% for the expandor. Author

N65-24819# Hughes Aircraft Co., Los Angeles, Calif. Microwave Tube Div.
APPLIED RESEARCH ON EFFICIENCY IMPROVEMENT IN O-TYPE TRAVELING-WAVE TUBES Interim Engineering Report, 15 Oct. 1964–15 Jan. 1965
O. Sauseng Wright-Patterson AFB, Ohio, Systems Eng. Group Jan. 1965 59 p refs
(Contract AF 33(615)-1951)
(IER-2; AD-612115)

A single velocity step taper was tested in the demountable apparatus. Investigations of such step velocity tapers are part of this program to evaluate methods to resynchronize the beam modulation with the circuit wave of traveling-wave amplifiers at large signal levels. Improvements of the electronic efficiency of nearly 30% over that of the standard circuit were observed, while the depressed efficiency was about the same. A design evaluation of the taper section on the basis of a large-signal computer analysis for step tapers showed good qualitative agreement with predictions. The step-taper was estimated to be too large, while it had about the correct velocity step magnitude for the test conditions. Investigations indicate that at lower beam perveances the beam flow appears to change from a highly nonlaminar to a much more laminar Brillouin flow. At low beam perveances and apparent laminar flow conditions the efficiency is significantly increased. At these conditions efficiencies up to 50% were observed. At frequencies near the lower cutoff a beam loading effect in the circuit properties was noted. The tube parameters are then considerably changed from those obtained with cold circuit measurements. An accurate spent beam velocity analyzer was developed for detailed efficiency evaluations. Effects of the electrostatic potential distribution, the secondaries and the space charge on the accuracy of the analyzer are discussed. The beam analyzer also provides electron optical information about the beam. Author

N65-24839# Watkins-Johnson Co., Palo Alto, Calif.
DEVELOPMENT OF AN E-BAND AMPLIFIER Final Report, 10 Jan. 1961–15 Dec. 1964
E. W. Kinaman and D. E. Miller Griffiss AFB, N. Y., RADC, Apr. 1965 131 p refs
(Contract AF 30(602)-2422)
(RADC-TR-65-118; AD-462156)

Techniques were developed and applied culminating in several practical wideband amplifiers. The highest overall gain noted was 45 dB at 93.75 Gc with best noise figure at 16 dB. Operation from 68 to over 100 Gc was demonstrated, but the practical instantaneous bandwidth was limited to 15 or 20 Gc in each case due to circuit dispersion. Continuance toward a field-type model is strongly recommended on the basis of the demonstrated feasibility and present radiometric need. Extension of this development to the 1- to 2-mm region is now entirely practical. In addition, cryogenic operation can remove the criticalness from the focusing components and conceivably result in a 6-dB noise-figure device with 45 Gc bandwidth centered at the 3.2-mm atmospheric window. Author

N65-24868*# Space Technology Labs., Inc., Redondo Beach, Calif. Physical Electronics Lab.
A NOVEL HIGH VOLTAGE PULSE GENERATOR
J. F. Friichtenicht and D. O. Hanson 15 Apr. 1965 6 p refs
(Contract NASw-936)
(NASA-CR-63137; STL-4158-6006-TU-000) CFSTI: HC $1.00/MF $0.50

A high voltage pulse generator is described which contains all solid-state components, except for the output pulse tube. The generator is simple in design and is driven by a 3-V pulse. The biasing arrangement allows the switching action of the transistors and at the same time prevents the voltage across any transistor from exceeding that across its bias resistor. The high voltage tube is conventional in all respects. The rise and fall times of the output pulse were about 900 nsec. If shorter rise and fall times are required, both stages of the pulse generator can be improved. Circuit diagrams are included. E.E.B.

N65-24981*# Kinelogic Corp., Pasadena, Calif.
ELECTROSTATICALLY DRIVEN CAPACITOR PROJECT Final Technical Report
5 May 1964 65 p Prepared for JPL
(Contracts NAS7-100; JPL-950668)
(NASA-CR-63111) CFSTI: HC $3.00/MF $0.75

Theoretical expressions for the static values for capacitance, electrostatic force, and conversion efficiency were obtained for an electrostatically driven capacitor, and three proof-test-models were constructed. Results of preliminary tests on these test models and two prototype units are presented in tabular form and show a very stable resonance frequency. The critical quantities which affect the frequency are the thickness of the membrane and the gold plating, the effective area of vibration and the heat treatment of the diaphragm. The magnitude of the pickup voltage for each capacitor ranged from 12 to 26 millivolts rms. A conversion efficiency drop to one-half its room temperature value at 90° C and a frequency variation of 50 cycles per second in further tests was believed to be caused by the uneven expansion of the clamping screw. G.G.

N65-24994*# ADCOM, Inc., Cambridge, Mass.
ADVANCED THRESHOLD REDUCTION TECHNIQUES STUDY Second Quarterly Report, 1 Oct.–31 Dec. 1964
[1964] 59 p refs
(Contract NAS5-9011)
(NASA-CR-62963) CFSTI: HC $3.00/MF $0.50

Research continues on the feasibility of reducing the noise threshold for demodulating FM signals at least 3 dB below the

threshold experienced with a second-order PLL demodulator whose design is optimized for best threshold performance in demodulating a given signal. The evaluation and analytical study of proposed threshold reduction techniques and data on the design and instrumentation of the experimental test setup were also continued. A performance evaluation of several band dividing techniques motivated by limitations in the original work of Akima, a synopsis of the experimental program effort which consisted of the completion of the automatic test system and the implementation and tests of second-order loops, and a discussion of the synthesis of higher order PLL demodulators are included. S.C.W.

N65-24995*# Auburn Research Foundation, Inc., Ala. Microwave Research Lab.
DEVELOPMENT OF FM TELEVISION TRANSMITTER. DEVELOPMENT OF RADAR ALTIMETER RETURN PULSE MEASUREMENT SYSTEM. MILLIMETER PROPAGATION STUDY Second Quarterly Report, 1 Jun.–1 Sep. 1964
H. M. Summer [1964] 37 p
(Contract NAS8-11184)
(NASA-CR-62961) CFSTI: HC $2.00/MF $0.50

Results are given of tests on the Model six FM Television Transmitters, the development of the radar-altimeter instrumentation system, and the millimeter wave study. Five FM transmitters of the Model six series (Serial No. 6, 8, 9, 10 and 11) were built and tested. The results of these tests are included. The circuitry of the radar altimeter return pulse measurement system was placed on vector boards and rack mounted; and a description of modifications made on the system is included. Part of the equipment for the millimeter propagation study was installed, and preliminary tests were run on a linear material for the propagation chamber. Author

N65-25019 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
HELICAL-COAXIAL PHASE SHIFTER
W. J. Bleackley *In its* Bull. of the Radio and Elec. Eng. Div., V. 14, No. 3, Jul.–Sep. 1964 [1964] p 17–20 (See N65-25013 14-07)

A novel mechanical phase shifter is described which has no moving electrical contacts, no reciprocating parts, and is capable of high speed rotation. The structure employs a loosely wound helix, and control is effected by both the translation and rotation of a worm having the same pitch as the helix. The same basic structure would also act as a variable attenuator. Also reported is the fabrication of two worms made of material having a high dielectric constant and low loss tangent, which were used to minimize changes in loss with phase shift. Illustrated are phase shifters suitable for low and high power applications, and a completed high power helical–coaxial phase shifter. S.C.W.

N65-25056 Joint Publications Research Service, Washington, D. C.
AMPLIFIER WITH GAIN CONTROL
V. K. Rayev *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 310–317 refs (See N65-25031 14-10) CFSTI: $8.28

The design of a magnetic amplifier with gain control is based on a scheme which combines the magnetic amplifier with a direct current output and a negative feedback loop around it through a triode switch and a pulse-width modulator. The latter makes the triode operate in the switching mode while the control signal is continuous. Author

N65-25057 Joint Publications Research Service, Washington, D. C.
PULSE SOURCES FOR CONTACTLESS TELEMECHANICAL SYSTEMS WITH NONSYNCHRONOUS FEEDING
V. N. Silayev *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 318–346 refs (See N65-25031 14-10) CFSTI: $8.28

Results of experiments with stroke pulse shapers that are connected to the master stage of contactless telemechanical systems with time separation and nonsynchronous feeding is discussed. Considered were shapers connected through the differentiator transformers which were directly connected to the triode collector chains, and shapers connected to the transformer in the feedback system. It was found that connection of the shaper to the master stage through the differentiator transformers decreases its effect on the frequency stability of the master stage by a factor of 100 to 200, as compared to the second method of connection. The possibility of constructing highly reliable and effective stroke impulse shaper circuits with four-layer switching diodes is investigated for (1) circuits fed by a source of periodic oscillations; and (2) circuits fed from a source of direct current. The replacement of silicon triodes for germanium triodes in several experimental multivibrator circuits showed the best thermoresistance for a classical multivibrator circuit with silicon triodes. G.G.

N65-25073 Joint Publications Research Service, Washington, D. C.
DIFFUSION TECHNIQUE IN THE MANUFACTURE OF TRANSISTORS
Chen-ching Wang *In its* Transl. on Communist China's Sci. and Technol., No. 180 17 May 1965 p 41–58 refs Transl. into ENGLISH from Wu-hsien-tien Chi-shu (Peking), no. 4, Oct. 1964 p 15–21; 14 (See N65-25069 14-34) CFSTI: $3.00

A discussion of the diffusion method and the diffusion problem of impurities in the manufacture of germanium, silicon, and germanium arsenic transistors is presented. A theoretical analysis of the basic concept of diffusion, emphasizing the flow of atoms in a solid and the variation in atomic concentration, is included. Three forms of the distribution of impurities are considered: Gauss distribution, the distribution of error function, and the distribution of index. Also discussed are growth remelting, alloy, vacuum, and box diffusion methods, and gas carrying diffusion in dual temperature zones. S.C.W.

N65-25097 IIT Research Inst., Chicago, Ill.
STUDY OF LOW-FREQUENCY FIELDS FOR COAXIAL AND TWISTED-PAIR CABLES
J. E. Bridges *In its* Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 475–495 refs (See N65-25075 14-07)

An empirical and theoretical study was made of external magnetic fields arising from cables and cabling systems in the frequency range where skin depth is considerably greater than wall thickness of the outer conductor. A 300-ohm TV twin-lead cable, a 7/8-inch diameter solid-copper coaxial cable, an RG 58U flexible coaxial cable, an RG 594 flexible coaxial cable and a no. 29 gage twisted-pair cable were tested. Typical plots of radial and axial leakage fields were obtained near the terminations, along the cable, and at some distance from the cable. Theoretical analysis and laboratory measurements disclosed that the external low frequency magnetic fields can arise from coaxial cables if the outer and inner conductors are slightly offcenter or if unsymmetrical current distributions

occur on the inner and other conductors. External-field behavior and susceptibility of a coaxial cable may be characterized by an equivalent open wire pair. Twisted pair cables exhibited far less susceptibility or leakage fields than all coaxial cables tested at distances substantially larger than the spacing between twists. To predict susceptibility and mutual coupling of coaxial or twisted pair cables, consideration should be given to controlling mutual coupling parameters during manufacture, test and installation. Author

N65-25120 Joint Publications Research Service, Washington, D. C.
THE PRESENT STATE AND FUTURE TENDENCY OF ENVIRONMENT TESTS OF ELECTRONIC EQUIPMENT
Te-pi Wu *In its* Transl. on Communist China's Sci. and Technol., No. 179 17 May 1965 p 81–102 Transl. into ENGLISH from K'o-hsueh T'ung-pao (Peking), no. 3, 17 Mar. 1965 p 242–250 (See N65-25114 14-34) CFSTI: $4.00

Environmental testing including test design, environment modeling, methods, and measurement is reviewed. Weather environment simulation of temperature, humidity, atmospheric pressure, radiation, rainfall, mildew and decay, fog, and sand and dust are considered. Further, the simulation of induced environment–vibration, impact, thermal stress, acceleration, and transportation is discussed. E.E.B.

N65-25226# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
POTENTIAL LOGICAL INVERTER WITHOUT COMMUTATION ELEMENTS
L. A. Vereshchagin and N. M. Rudnyy 8 Dec. 1964 6 p Transl. into ENGLISH from Avtomat. i Priborostr. (USSR), no. 1, 1964 p 45–47
(FTD-TT-64-642/1+2; AD-610324)

An inverter is described which is essentially a bridge circuit characterized by simplicity and reliability. The inverter can operate on alternating current or pulsating current. One diagonal of the bridge is connected with the power supply and the other diagonal with the input. The output signal is taken from one of the bridge resistances. E.E.B.

N65-25231# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station
QUARTZ CRYSTAL AGING EFFECTS Quarterly Report, 15 Aug.–15 Nov. 1964
R. B. Belser and W. H. Hicklin 15 Nov. 1964 83 p refs
(Contract DA-36-039-AMC-02251(E))
(QR-7, AD-463379)

Aging measurements continued on quartz resonators of 10-Mc frequency for evaluation of various types of bonding cements. Performance over a period of 55 to 190 days at a temperature of 85° C revealed that units bonded with any of the cements were able to fulfill an aging requirement of less than 1 in 10^7 per week at both the fundamental frequency and the third overtone. However, the surface finish of units bonded with bakelite–silver or pyroceram–silver was more critical than for the more plastic materials and cements. During the last 30 days of a 55- to 190-day period well over 50% of the units exhibited aging less than 10 parts in 10^8. Bakelite–silver gave the poorest performance throughout. An exposure of the units to 300° C for 5 minutes will be conducted before final evaluation. Aging and mode analyses studies by X-ray diffraction and other methods were also continued for an extensive series of units of each resonator type. A series of standing wave patterns were obtained showing 3, 5, and 7, half-wavelengths along the x dimension. E.E.B.

N65-25238# Boeing Co., Seattle, Wash.
PROTON AND ELECTRON PERMANENT DAMAGE IN SILICON SEMICONDUCTOR DEVICES
R. R. Brown [1964] 27 p refs Presented at the Joint Conf. of Am. Nucl. Soc. and Am. Soc. for Testing and Mater., Syracuse, N.Y., Oct. 1964
(D2-90570)

Data is presented on permanent radiation damage in silicon diodes, p-on-n solar cells, and both n-p-n and p-n-p transistors. This information was accumulated from proton (2 and 10-Mev) and electron (2 and 5-Mev) irradiation tests. Selected transistors of the following constructions were tested: grown, diffused mesa, diffused planar, and epitaxial planar. Anomalous current gain degradation was observed for irradiated transistors operating at low currents. This damage has been shown to be the result of ionization-induced changes in surface recombination velocity. Transistor damage constants for displacement damage from proton and electron irradiation tests are compared with those found from neutron and gamma ray tests. Author

N65-25283# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
INVESTIGATION OF A PRAGMATIC TECHNIQUE FOR PRESELECTING RADIATION RESISTANT SEMICONDUCTOR DEVICES
M. L. Rossi and G. H. Bolles Dec. 1964 20 p refs
(RM-259J)

A nondestructive method for selecting radiation-resistant semiconducting devices was investigated. The full technique involves the controlled laboratory irradiation of devices, subsequent temperature annealing, and then use of the devices that are found to be most radiation resistant. Two series of radiation-annealing experiments were performed. In the first, the radiation damage caused by exposure to 6.6×10^{15} 1-MeV electrons/cm^2 was annealed from 1N645 silicon diodes. In the second series, radiation damage caused by 1.9 MeV electrons at similar integrated flux levels was annealed from both 1N645 and 1N1563A diodes, and on reirradiation the annealed devices were found to be as radiation resistant as the first time. Author

N65-25330# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
AN IMPROVED CARTRIDGE TYPE LINEAR VARIABLE DIFFERENTIAL TRANSFORMER
W. B. Weihermiller Jan. 1965 11 p ref
(Contract AT(45-1)-1830)
(BNWL-15) CFSTI: $1.00

Development, testing and design of a cartridge type linear variable differential transformer are described. Its features provide free linear movement without measurable lateral deflection, high resistance to clamping forces, low hysteresis, longer maintenance free operation, and easier maintenance. Author

N65-25340# SFD Labs., Inc., Union, N. J.
RESEARCH AND DEVELOPMENT ON L-BAND CROSSED-FIELD AMPLIFIER CHAIN Quarterly Progress Report No. 6, 1 Mar.–1 Jun. 1964
H. L. Mc Dowell Jul. 1964 33 p
(Contract AF 30(602)-2533; ARPA Order 136.61)
(RADC-TR-65-79; AD-613994)

Life tests continued on Group C SFD-209 tubes; 4411 hours were accumulated. Tubes L48E and L1E operated 2150 and 1288 hours, respectively. L1E was damaged by an equipment

failure and has been removed from life test for study. To prevent future failures, the external circuitry has been improved and the final tubes modified. Tube L30E was used in investigating the improvement of efficiency through improved confinement of electrons to the interaction space accomplished by a barreling magnetic field. That no significant change in efficiency was observed is believed to indicate that the confinement is already quite adequate. Further tests indicate the V-I characteristics will be quite reproducible from tube to tube. Sources of variations previously noted were found to be external to the tube. On the basis of performance and life tests, the control electrode support and the input window have been redesigned. Author

N65-25402*# Space Technology Labs., Inc., Redondo Beach, Calif. Physical Electronics Lab.
SOLID STATE HIGH VOLTAGE PULSER
David O. Hansen 12 Mar. 1965
(Contract NASw-936)
(NASA-CR-63173; STL-4158-6005-TU-000) CFSTI: HC $1.00; MF $0.50

A circuit which will produce a moderately fast rising high voltage pulse is described. Developed in connection with research on hypervelocity impact phenomena, the advantages of this circuit are: (1) It is constructed of solid state components. (2) It has low voltage requirements at the input for turn-on. (3) With the rapidly increasing BV_{CEO} of PNP transistors, it has the availability of either polarity pulse without transformer coupling. (4) It has inherent protection against high voltage breakdown which is provided by the biasing arrangement. This circuit was used as a driving source for a 20-kV pulse tube. A diagram is included. S.C.W.

N65-25429# Joint Publications Research Service, Washington, D. C.
PECULIARITIES OF THE USE OF SEMICONDUCTOR DEVICES
N. Smirnov et al 9 Jun. 1965 13 p Transl. into ENGLISH from Radio (Moscow), no. 2, Feb. 1965 p 53–56
(JPRS-30522; TT-65-31220) CFSTI: $1.00

It was pointed out that proper use of semiconductor devices rests on their operation in their respective modes, and in circuit designs that take into account the changes in device parameters under operating conditions. The great dependence of semiconductor materials on temperature explains the sensitivity of semiconductor devices to short current voltage and power overloads. The basic characteristics and parameters of rectifying diodes, high frequency diodes, pulse diodes, stabilitron diodes, controlled and uncontrolled switching diodes, varicaps, tunnel diodes, and some transistors types are discussed, and several classification lists are shown. G.G.

N65-25445# General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
RADIATION EFFECTS RELIABILITY AND DATA ANALYSIS Quarterly Progress Letter No. 2, Jul.–Sep. 1964
[1964] 51 p refs
(Contract AF 29(601)-6308)
(AD-461032)

The Weibull distribution function is used to describe the radiation reliability data thus far analyzed. Although other models appear as good or better in certain cases, the Weibull function covers a much broader range of application. The bulk of the data are presented as Weibull plots; however, in some cases a log-normal and/or extreme value plot are included to show the graphical similarity of the mathematical functions. Data are considered for transistors and diodes irradiated from reactor and Co-60 sources. E.E.B.

N65-25469# SFD Labs., Inc., Union, N. J.
RESEARCH AND DEVELOPMENT ON L-BAND CROSSED-FIELD AMPLIFIER CHAIN Quarterly Progress Report No. 7, Jun.–Sep. 1964
H. L. McDowell and A. Wilczek Oct. 1964 34 p
(Contract AF 30(602)-2533; ARPA Order 136-61)
(RADC-TR-65-82; AD-613995)

Life tests were continued on the Group C, SFD-209 tubes. Tubes L30E, D37F, and L48E are operating in parallel from a common rf source and dc power supply. A total of 8349 hours of operation has been accumulated. Apparent degradation of performance was traced to external circuit faults. Construction of the new Group D design was started. These tubes incorporate changes found necessary as a consequence of life tests. These changes include improved control electrode cooling, and a new input window. Tubes F63F and G35F of the new Group D design were tested and found to be satisfactory. Tube G35F was used to observe the effects of increased anode-cathode separation. The increased separation allows operation in the region of lower power output, where under conditions of less separation, the output would contain some π-mode oscillations. Starting delay in tube G35F was also studied. Starting delay times of less than 20 nanoseconds were observed for 5 kW peak input over a 1000 V range of cathode voltage encompassing the normal operating values. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N65-24400# New York Univ., N. Y. Lab. for Electroscience Research
THEORY AND DESIGN OF FREQUENCY CONVERTERS USING COMBINATIONS OF PARAMETRIC ELEMENTS Fourteenth Scientific Report
Jacob Klapper Feb. 1965 129 p refs *Its* Tech. Rept.-400-105
(Contract AF 19(628)-379)
(AFCRL-65-105; AD-614122)

A discussion of the theory, gain and bandwidth limitations, and optimum design of frequency converters comprised of both reactive and resistive nonlinear elements, is presented. A design procedure is developed which results in an optimum gain bandwidth performance for any coupling circuit complexity. The center of the passband is made to coincide with that of the isolation band. An illustrative example considers a bandwidth of about 120% of the center frequency. Author

N65-24456# Research Triangle Inst., Durham, N. C.
INTEGRATED SILICON DEVICE TECHNOLOGY. VOLUME VI: UNIPOLAR TRANSISTORS Technical Documentary Report, Jun.–Dec. 1964
J. R. Hauser Mar. 1965 253 p refs
(Contract AF 33(615)-1998)
(ASD-TDR-63-316, Vol. VI; AD-613951)

Theory and design parameters for unipolar (field effect) transistors in integrated circuits are discussed. The theory and characteristics of junction and surface metal oxide semiconductor (MOS) unipolar transistors are presented. A detailed discussion is given of both the dc and small signal ac characteristics. Design considerations for unipolar transistors in integrated circuits are outlined. Included are discussions of isolation problems, topological design, and compatibility of integrated unipolar transistors with other circuit components. Design examples are given of unipolar transistors

for integrated circuits. Some possible circuit applications of unipolar transistors are also discussed. Author

N65-24534 Joint Publications Research Service, Washington, D. C.
ON THE STEADY-STATE MODE OF AN OPTICAL QUANTUM TRAVELLING WAVE AMPLIFIER WITH FEEDBACK
N. D. Milovskiy *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 103–117 refs (See N65-24525 14-07) CFSTI: $7.00

Passage of a plane electromagnetic wave through a layer of nonlinear active substance is analyzed. With the assumption that there is no reflection at the boundaries of the active layer, the solution can be found in the form of a traveling wave whose amplitude and phase vary slowly. The obtained results are used for determining the gain of a quantum traveling-wave amplifier and the radiated power of an optical traveling-wave generator. Author

N65-24539 Joint Publications Research Service, Washington, D. C.
THEORY OF MODULATED CIRCUITS
V. S. Etkin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 177–185 refs (See N65-24525 14-07) CFSTI: $7.00

Described is an apparatus which solves integral equations of forced oscillations for any system with periodically modulated parameters, and which gives results in a frequency range suitable for the analysis of super-high-frequency devices. Author

N65-24540 Joint Publications Research Service, Washington, D. C.
THEORY OF "MODULATOR–DEMODULATOR" TYPE AMPLIFIERS
Ye. S. Karmanova and V. S. Etkin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 186–193 refs (See N65-24525 14-07) CFSTI: $7.00

The possibility of using amplification in circuits consisting of a modulator with nonlinear capacitance and a demodulator with nonlinear resistance, which are called modulator–demodulator-type amplifiers, was studied previously. In the present article, the transfer constant and the noise factor of such an amplifier are computed on the basis of results obtained earlier. Author

N65-24541 Joint Publications Research Service, Washington, D. C.
NONLINEAR EFFECTS IN A MAGNETOSTATIC AMPLIFIER AND GENERATOR
A. V. Vashkovskiy *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 194–204 refs (See N65-24525 14-07) CFSTI: $7.00

The limitation mechanism for the generation amplitude due to nonlinearity in the generation frequency is considered. Author

N65-24693# Joint Publications Research Service, Washington, D. C.
TWOFOLD INVARIANCE OF AUTOMATIC CONTROL SYSTEMS
B. N. Petrov and V. Yu. Rutkovskiy 31 May 1965 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 161, no. 4, 1965 p 789–790
(JPRS-30355; TT-65-31118) CFSTI: $1.00

Certain nonscanning self-tuning automatic control systems, defined by equations for plant parameters, servomechanism, control law, and for law of readjustable coefficients, are proved to twofold invariant when the plant parameters remain unchanged after any arbitrary change in the system. After these parametric equations are substituted into the general equations for an automatic control system, the system is reduced to a single equation, and it is shown that the nth order operator does not depend on the plant parameters, which establishes the proof. It is noted that the specified systems are invariant also with respect to the servomechanism parameters and constants in the reduced equation. J.M.D.

N65-24923*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE ROTATING SUPERCONDUCTOR. PART III: THE SUPERELECTRONS AS AN INCOMPRESSIBLE CHARGED FLUID
M. M. Saffren 31 May 1965 9 p refs
(Contract NAS7-100)
(NASA-CR-63062; JPL-TR-32-650, Pt. III) CFSTI: HC $1.00/MF $0.50

The theory of the superfluid without the London constraint is explored. For brevity, we call this theory BSH theory after its original promulgators. We note its similarity to and differences from the London theory. In particular, we examine the BSH theory as it applies to a hollow cylinder, at rest and rotating, and with and without an applied field. Author

N65-24961 European Organization for Nuclear Research, Geneva (Switzerland). MSD Div.
DISTORTION OF FAST PULSES IN COAXIAL CABLES. NUMERICAL ANALYSIS AND APPLICATIONS
G. Brianti 3 May 1965 32 p refs
(CERN-65-10)

The problem of the pulse response of matched coaxial cables is discussed in terms of a relatively simple theory covering the frequency range from a lower limit of a few hundred kHz to the first cutoff frequency of the cables above which other modes of propagation predominate and the attenuation is very high (cable no longer usable). The mathematically simple theory is reviewed and a method of numerical analysis suitable for calculation and computer operation by means of Fortran programs is indicated. As an illustration of the method, the case of a photomultiplier output is treated and the possible use of the results indicated. E.E.B.

N65-24984*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DIGITAL CONTROL OF A SECOND-ORDER LINEAR AFC SYSTEM WITH A LARGE TIME DELAY
Robert Boyer 30 Aug. 1962 112 p refs
(Contract NAS7-100)
(NASA-CR-63110; JPL-TM-33-98) CFSTI: HC $4.00/MF $0.75

The construction and nonlinear aspects of phase-locked-loop and automatic frequency control systems are discussed. The nonlinear systems are approximated by linear systems, and a time lag is introduced into the system. Several methods of designing a digital controller for a second-order system with a large time lag are investigated. The time lag is assumed to be 10 to 20 times larger than the sampling period. The principal criterion used is the deadbeat response to a ramp input, although other criteria are considered. Several illustrations of the type of system response attainable with these digital controllers are presented to enable the reader to judge the merits of this controller for his particular application. Author

N65-24992*# Stanford Univ., Calif. Electronics Labs.
QUARTERLY RESEARCH REVIEW NO. 11, 1 OCTOBER–31 DECEMBER 1964

W. R. Rambo [1965] 172 p
(Grants NsG-299-63; NsG-555; Contracts AF 33(657)-11144; AT(04-3)-326; Nonr-225(24) et al)
(NASA-CR-63088; SEL-64-133) CFSTI: HC $5.00/MF $1.00

Unclassified research activities conducted at the Electron Devices Laboratory, Solid-State Electronics Laboratory, Systems Theory Laboratory, and the Radioscience Laboratory are reviewed. Included are data on plasma studies, quantum electronics, system theory, and electron tubes. S.C.W.

N65-25031# Joint Publications Research Service, Washington, D. C.
THE THEORY AND APPLICATION OF AUTOMATIC SYSTEMS
Ya. Z. Tsipkin, ed. 26 May 1965 529 p refs Transl. into ENGLISH from Teoriya i Primeneniye Avtomat. Sistem (Moscow), 1964 p 3–341
(JPRS-30270) CFSTI: $8.28

Statistical methods in automation, theory of reliability, optimization, and related systems are reviewed. For individual titles see N65-25032–N65-25068.

N65-25034 Joint Publications Research Service, Washington, D. C.
ONE METHOD FOR EVALUATING THE PARAMETERS OF AN OBJECT
Ye. P. Maslov *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 30–45 refs (See N65-25031 14-10) CFSTI: $8.28

For control systems where there is little or no a priori information about the object being controlled, methods are discussed by which such information can be obtained without disturbing the normal operation of the system. Where a sampling distribution is postulated for the multiple characteristics of the object, the statistical estimation of the parameters proceeds from measurement of the input and output signals of the object. Bayes' formula is used for determining a conditional probability distribution on the possible parameter values, based on a likelihood function for the signal values and an assumed a priori distribution for the parameters. J.M.D.

N65-25035 Joint Publications Research Service, Washington, D. C.
CONDITIONS OF UNIQUENESS OF A DISCRETE OPTIMUM NONLINEAR SYSTEM WITH FINITE MEMORY
Yu. F. Kichatov *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 46–57 ref (See N65-25031 14-10) CFSTI: $8.28

Problems in estimating an unknown parameter by a random process of an arbitrary number of variables, where the random process is represented by a truncated Taylor series, are analyzed. The criterion of optimal estimation is minimization of the mean squared difference between the parameter and the Taylor series. The normal equations resulting from differentiation of the mean squared difference with respect to the coefficients produce a matrix which is not necessarily singular. Conditions under which singularity, and therefore unique solutions for parameter estimates, will exist are investigated. J.M.D.

N65-25036 Joint Publications Research Service, Washington, D. C.
SOME QUESTIONS OF EXISTENCE AND UNIQUENESS, RELATED TO THE MULTI-DIMENSIONAL EXPONENTIAL DISTRIBUTION
Ye. S. Kochetkov *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 58–77 refs (See N65-25031 14-10) CFSTI: $8.28

If $X = (x_1, \ldots, x_n)$ and $Y = (y_1, \ldots, y_n)$ are random vectors identically distributed as multivariate normal variables with zero expectations, then the vector $Z = (z_1, \ldots, z_n)$ whose elements are $z_i = x_i^2 + y_i^2$ will have an exponential distribution. It is shown that the characteristic function for Z can be expressed as $|C| / |C - iT|$ where i is the square root of minus unity, T is the diagonal matrix whose nonzero elements are the constants in the characteristic function, and where C is positive definite and can be determined uniquely. It is also established that the characteristic function for Z can be written as the reciprocal of a multilinear function which itself is exponentially distributed. J.M.D.

N65-25037 Joint Publications Research Service, Washington, D. C.
CERTAIN PROBLEMS OF ANALYSIS AND SYNTHESIS OF RELIABLE SWITCHING CIRCUITS
V. D. Malyugin *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 78–85 refs (See N65-25031 14-10) CFSTI: $8.28

A method is proposed for synthesizing reliable switching circuits which are based either on relay or valve elements. The presentation is restricted to relay switching circuits which execute the work of one element but with higher reliability than a single element, and which are composed of an input and output pole and relays which are switched on simultaneously. Associated with this circuit is a binomial function which expresses the probability that an arbitrary number of elements will be closed somewhere between the poles while all relays are on, resulting in shutdown of the circuit. A second binomial function is formulated which gives the probability that the circuit will remain open when some number of elements are closed. It was found that the reliability of any such relay circuit is determined by these probability functions, and that the method can be extended to bilateral gating circuits. J.M.D.

N65-25038 Joint Publications Research Service, Washington, D. C.
MINIMIZATION OF A STRUCTURE OF MULTIFUNCTIONAL DEVICES OF DISCRETE TECHNIQUES
Ye. S. Sogomonyan *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 86–100 refs (See N65-25031 14-10) CFSTI: $8.28

A method for designing a control system with the minimal set of devices and logic conditions for converting various continuous electrical signals into discrete values is presented. The method is illustrated in construction of a control node for the parameters of universal logic machines for controlling complicated electrical objects. The parameters are voltage, current, phase shift, resistance, and time interval; eight different devices and four logic conditions are considered as candidates. A Boolean logic expression which consists of the conjunction of the disjunctive normal forms of variables representing the devices and logic conditions is proposed, whose expansion leads to identification of three devices and three logic conditions which together are sufficient for conversion of the electric parameters. J.M.D.

N65-25039 Joint Publications Research Service, Washington, D. C.
APPLICATION OF AUTOMATIC CONTROL SYSTEMS WITH VARIABLE STRUCTURE FOR COMPENSATION OF DISTURBANCES APPLIED TO DIFFERENT OBJECT POINTS
V. T. Utkin *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 101–110 refs (See N65-25031 14-10) CFSTI: $8.28

The application of a system with variable structure for object control where disturbances are applied to many of its

points, permits full reproduction of the reference input. The system is rough with respect to the variation in the object parameters. To construct the control law, less information is required on the behavior of the system than in the invariant system where in addition, the condition of physical realizability is carried out. Author

N65-25040 Joint Publications Research Service, Washington, D. C.
APPLICATION OF AUTOMATIC CONTROL SYSTEMS WITH VARIABLE STRUCTURE FOR CONTROLLING OBJECTS WITH ZEROES IN THE TRANSMISSION FUNCTION
N. Ye. Kostyleva *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 111–122 refs (See N65-25031 14-10) CFSTI: $8.28

The equations of motion of an object in an automatic control system with variable structure are investigated. Discussion applies to objects whose transmission functions contain zeroes, and the control law for the system is in the form of a discontinuous function. The system of differential equations of motion of the particle are analyzed with respect to stability of the object. Systems whose phase trajectories are continuous and discontinuous in the space of control coordinates and derivatives are discussed. J.M.D.

N65-25041 Joint Publications Research Service, Washington, D. C.
ROUGHNESS OF MOTION OF A SYSTEM AND ROUGHNESS OF NONLINEAR SYSTEMS WITH CONSTANT PARAMETERS
E. M. Solnechnyy *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 123–146 refs (See N65-25031 14-10) CFSTI: $8.28

A concept of roughness in the motion of a dynamic system is formulated for use in evaluation of such systems. Roughness in the general context of dynamic systems pertains to amount of change in certain properties of the system as a result of small variation in system parameters. The specific concept discussed here is a generalization of the Lyapunov theory of stability, and the criterion for measurement of roughness is based on Laplace's study of the transformation of a function describing motion of the system, which is then applied to linear systems with constant parameters, including systems with lumped parameters. J.M.D.

N65-25042 Joint Publications Research Service, Washington, D. C.
THE PROBLEM OF TERMINAL CONTROL
L. S. Kirillova *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 147–155 refs (See N65-25031 14-10) CFSTI: $8.28

Determination of the optimal terminal control is considered for the motion of an object described by the system of equations $dx/dt = Ax + Bu$, where A(t) and B(t) are time dependent matrices of order n by n and n by r respectively, x(t) is a vector of n phase coordinates, and u(t) is a vector of conetrol of order r satisfying the conditions $|u_i| \leq 1$. The time of motion T of the object is fixed. The admissible controls u(t) form a class D, and the problem of finding the optimal control consists of finding the value which minimizes the functional $I = g(x_1^T, \ldots, x_n^T)$ where I is an explicit function of the final position of the object and is continuous in the space to which the x-vector belongs. The existence of such an optimal control, and some difficulties in determining it, are analyzed. J.M.D.

N65-25043 Joint Publications Research Service, Washington, D. C.
FREE OSCILLATIONS OF LINEAR SYSTEMS WITH VARIABLE PARAMETERS
V. S. Kosikov *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 156–167 refs (See N65-25031 14-10) CFSTI: $8.28

Application of the method of frozen coefficient to systems of automatic adjustment whose parameters are subject to variation is considered. This method was derived for systems where the parameters vary but little, or are unchanging. When this technique is applied to systems with variable parameters for study of free oscillations, it is possible to obtain solutions of linear equations with variable parameters independently of the form of the function which expresses the parameter variations, and it is possible to estimate stability of the system with relative ease. It was found that for such a system to be stable, Re $\gamma_i < 0$ is a necessary and sufficient condition. J.M.D.

N65-25044 Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF A SINGLE RELAY SYSTEM WITH CONTROL DISTURBANCES AND SWITCHING OF THE CONTROL LAW VARIABLE IN TIME
V. I. Popov *In its* The Theory and Appl. of Autom. Systems 26 May 1065 p 168–180 refs (See N65-25031 14-10) CFSTI: $8.28

The advantages of delay compensation in automatic relay systems are investigated (1) by analyses of the automatic control system motion equation; (2) through the dynamics of the system; and (3) by compensation of delay through combined switching of real and ideal regulators. It was concluded that the introduction of a compensating coupling makes it unnecessary to take measures against a decrease of the delay magnitude in a regulator, since these measures may lead to complication of the regulator and increased manufacturing costs. G.G.

N65-25045 Joint Publications Research Service, Washington, D. C.
APPLICATION OF THEORY OF DUAL CONTROL TO PROBLEMS OF CONTROL WITH INDIRECT INDICES
V. P. Zhivoglyadov *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 181–192 refs (See N65-25031 14-10) CFSTI: $8.28

The theory of dual control is applied to the design of an optimum control system which uses for control all the information obtained by measurements of the output parameters and of the indirect indices. All calculations were done for a one-dimensional case. The relationship between the output parameters and the indirect indices can be described statistically. The same method can be applied for Markov objects with memory through replacement of the probability distribution densities of perturbations in the formula for risks with the joint probability distribution densities for the time vectors, respectively. G.G.

N65-25046 Joint Publications Research Service, Washington, D. C.
CONCERNING THE DESIGN OF PREDICTIVE SYSTEMS, WORKING UNDER CONDITIONS OF INTERFERENCES
V. N. Novosel'tsev *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 193–198 refs (See N65-25031 14-10) CFSTI: $8.28

Discussed is a control system where the moments of switching of the sign of the controlling action selected correspond to the trajectory which arrives at the assigned point in the minimum time; where the input signal of the system does not contain random components; and where the object and its model are identical. If random interferences appear in one of the channels of the control system, optimum control in a current moment of time is determined by the construction of a nonrandom signal which is equal to the mathematical expectation of the control signal in a real system for all future moments of time. A block diagram for such a system with interferences in the control channel to the input of the object is shown. G.G.

N65-25047 Joint Publications Research Service, Washington, D. C.

ON SETTING UP AN OPTIMUM PROCESS IN A REACTOR FOR OBTAINING ETHYLENE OXIDE WITH THE HELP OF AUTOMATIC SYNTHESIS EQUIPMENT

N. D. Dagkesamanskiy *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 199–208 refs (See N65-25031 14-10) CFSTI: $8.28

Presented is a system of equations for the calculation of the optimum process to obtain ethylene oxide from a mixture of ethylene and air in a heterogeneously catalytical tubular reactor with silver tablets as a catalyst. A model of the controlled process was formed, and the selection of the optimum temperature of refrigeration for the initial temperatures of the mixture was gained by computation. It was concluded that the rate of transformation at the reactor ouput is limited by the permissible limiting value of the internal temperature of the reactor. G.G.

N65-25048 Joint Publications Research Service, Washington, D. C.

CERTAIN QUESTIONS ON THE OPTIMUM CONTROL OF ELECTROEROSION MACHINES WITH WIRE ELECTRODES

P. F. Merabishvili *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 209–222 refs (See N65-25031 14-10) CFSTI: $8.28

The optimal control of electrical erosion in very thin wire electrodes of 0.1- to 0.02-mm diameter used to produce accurate reproductions of complicated profiles is discussed. Equations were formed to express the relationship between the magnitude of the interelectrode gap and the speed of the feed of the electrode and the burnout rate to determine the maximum stability of a control system. G.G.

N65-25049 Joint Publications Research Service, Washington, D. C.

ABOUT ONE CLASS OF PERCEPTRONS

V. N. Vapnik and A. Ya. Chervonenkis *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 223–234 refs (See N65-25031 14-10) CFSTI: $8.28

Discussed are the operating principles of a perceptron that is based on a recognition and cognitive circuit for finding a generalized portrait and threshold of recognition. The offered method of training always permits the finding of a weight $\lambda_1,\ldots,\lambda_n$ separating images when they exist. In the cognitive mode, a system of patterns is indicated and objects are shown which the machine must place in one of the patterns, or which it must reject. The distinguishing mode uses a system of patterns and an object which belongs to one of the patterns in the system. G.G.

N65-25050 Joint Publications Research Service, Washington, D. C.

ON "ELEMENTARY-LINKS" BIOLOGICAL CONTROL SYSTEMS

G. V. Voronin *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 235–252 refs (See N65-25031 14-10) CFSTI: $8.28

Elementary dynamic links which are widespread in biosystems are studied. In discussing types of cells in biological information processing systems and their dynamic organization, biological potentials are classified as due to operation of biological self-excited oscillators and which thus exist in the absence of external influences, or else arising in response to external stimuli. In experiments using a visual analyzer on frogs, the existence of four types of links in the retina is confirmed by analysis of response to sinusoidal stimuli of various frequencies. An approximate mathematical expression for the relationship between light stimulus and the resultant biopotential is presented. J.M.D.

N65-25052 Joint Publications Research Service, Washington, D. C.

SOME QUESTIONS ON THE SELF-ORGANIZATION OF IDENTIFYING DEVICES

V. N. Vapnik, L. M. Dronfort, and A. Ya. Chervonenkis *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 267–276 refs (See N65-25031 14-10) CFSTI: $8.28

The formal circuit describing the instruction of an automatic computer for identifying objects is presented, and its application for the instruction of a perceptron is discussed. The ability of the instructing device to learn to imitate any automatic machine of the L class with accuracy at an instructing sequence is defined, and a number of methods are considered for the selection and self-organization of structures intended for the recognition of an assigned system of images. G.G.

N65-25058 Joint Publications Research Service, Washington, D. C.

CERTAIN PROBLEMS IN THE DEVELOPMENT OF CONTACTLESS TELEMECHANICAL REMOTE-ACTING SYSTEMS

V. N. Silayev *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 347–369 refs (See N65-25031 14-10) CFSTI: $8.28

Methods for synchronization and cophasing in time systems for transmission of information, and phase shifts in time systems, are studied. A synchronization method is described whose master and slave generators resist frequency detuning and which ensures high correcting ability of the time system. For operation with a secondary packing channel, a duplex time system with two generators and two distributors in a control room is designed for remote control of concentrated and dispersed objects. It was found that the most efficient structure of a duplex time system for remote control along a wired communications channel is one in which the direction of transmission and reception of information is periodically changed with a simultaneous change in the functions of the master and slave generators. J.M.D.

N65-25060 Joint Publications Research Service, Washington, D. C.

LOW-FREQUENCY LOGIC ELEMENTS BASED ON FERRITE-DIODE TRANSFORMER CIRCUITS

Ye. V. Kartuzov *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 376–392 refs (See N65-25031 14-10) CFSTI: $8.28

For use in constructing logic operations, circuits are presented for a multifunction ferrite-diode element with one output, a dynamic trigger memory component, a dynamic trigger with a computing input, a time delay element, a one-digit code, and a binary computer. J.M.D.

N65-25061 Joint Publications Research Service, Washington, D. C.
PNEUMATIC MULTICHANNEL REGULATOR
T. K. Yefremova *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 393–416 refs (See N65-25031 14-10) CFSTI: $8.28

The function and applications of a transistorized pneumatic multichannel regulator and servomechanism control system are described. In discussion of devices and presentation of circuit diagrams, various topics are covered: block diagram of the multichannel PID-regulator with various regulations with respect to each channel, structure of multichannel regulator, realization of the components for a pneumatic multichannel regulator, and realization of a multichannel PID-regulator. J.M.D.

N65-25062 Joint Publications Research Service, Washington, D. C.
DIGITAL MODEL CONTROL DEVICE
A. Ya. Biryukov *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 417–444 refs (See N65-25031 14-10) CFSTI: $8.28

Based on recent development of combination analog–digital computers, a digital computer is described which solves mathematical approximation problems. A primary application of this model is to solution of differential equations, requiring input of initial conditions, coefficient values, and data. The mathematical operations are carried out in separate solution blocks which are interconnected by delta-modulated channels; the fundamental element in the decision blocks is a digital integrator in which numerical integration is performed according to the rectangular law. Topics covered in this report are structure of the digital model control device, assignment of the digital network and synchronization, synchronization of the joint operation of the decision blocks, control of input and output data, control of the operation of the blocks and the solution of the problem, manual operations of control by a model, switching and memory elements, power stage, typical mode of operation, control panel, and block diagram of the control device. Test results on the model indicate need for including a memory unit in the control device. J.M.D.

N65-25072 Joint Publications Research Service, Washington, D. C.
THE RECENTLY DEVELOPED ELECTRONICS INDUSTRY OF CHINA
P'ei-lin Lo *In its* Transl. on Communist China's Sci. and Technol., No. 180 17 May 1965 p 35–40 Transl. into ENGLISH from Wu-hsien-tien Chi-shu (Peking), no. 4, Oct. 1964 p 1–3 (See N65-25069 14-34) CFSTI: $3.00

A synopsis of the developmental history of the electronics industry in China is presented. Emphasized is the parallel development of electronics techniques and the electronics industry during the early part of the 20th century. Included is a review of progress achieved in the electronics industry in the past 15 years. Cited are the development of electron tubes, equipment parts, semiconductors, electronic measurement instruments, receivers, broadcasting equipment, and communications equipment. Speculation is made concerning the future impact of the electronics industry on the development of China's resources, agriculture, scientific technology, products and production techniques, and automation. S.C.W.

N65-25087 IIT Research Inst., Chicago, Ill.
ANALYSIS OF NON-LINEAR DEVICES BY USE OF HYPERBOLIC APPROXIMATING FUNCTION
M. J. Frazier, S. Morissette, and J. J. Krstansky *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 212–235 refs (See N65-25075 14-07)
(Contract N123(953)-35417A)

A technique is presented for approximating the single valued E–I or transfer characteristic of a symmetrical nonlinear device, such as a varistor, by use of the hyperbolic sine function. This method eliminates the necessity of determining power series coefficients, and will permit the effect of all higher-order nonlinear terms to be taken into account by the determination of either two or three constants of approximation. A straightforward graphical procedure is described for ascertaining the appropriate approximating constants from a plot of the characteristic for a given device. A general expression for the nonlinear product magnitudes resulting from a one- or two-frequency forcing function is derived. The resulting nonlinear product magnitudes are compact expressions involving tabulated hyperbolic Bessel functions. The theoretically predicted, and experimentally measured nonlinear product levels are compared for a typical device whose characteristic has been approximated by this technique. Author

N65-25110 International Business Machines Corp., San Jose, Calif.
HIGH VOLTAGE NANOSECOND DURATION; POWER LINE TRANSIENTS
N. D. Hayter *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 729–778 refs (See N65-25075 14-07)

The interruption of inductor current on power lines produces a limited pulse train. These pulse trains can have pulse repetition rates as high as 20 mc, amplitudes as high as 1000 volts, durations as short as 10 nanoseconds, rise times as fast as 2 nanoseconds, and a train length as long as 3 milliseconds. Transient transfer from the transient producing device to a digital device is via power lines. Power lines in conduit act as multiwire eccentric transmission lines. Power lines outside of conduit act as multiwire unbalanced transmission lines. At the junction of open wire and conduit, pulses are induced which flow on the outside of the conduit. These pulses are normally called conduit waves. The multiple reflections of transients in power lines cause additions and subtractions to produce power line resonance. The transfer from the power cord to the digital device is accomplished by line-to-line pulses coupling through the power supply and line-to-ground plane pulses coupling to the frame. These pulses, under the right conditions, cause digital equipment to malfunction. A three-year study of the phenomenon has produced enough information to design a transient simulation which forecasts a digital system's performance in a normal transient environment. Author

N65-25111 General Dynamics/Astronautics, San Diego, Calif.
ANALYTICAL PREDICTION AND SUPPRESSION OF INDUCTIVELY CAUSED TRANSIENTS
E. Haber and L. Jambor *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 779–813 refs (See N65-25075 14-07)

A simplified analytical method is presented of solution that will allow the prediction of transient functions (magnitude, duration, and response) during the design phase of systems that use relays and solenoids. The basic parameters needed for this analysis are the inductance of the device in question, the interwinding capacitance and the dc resistance of the coil. The inductance and the coil resistance are readily available to the designer; the interwinding capacitance can either be calculated

from the geometry of the coil or measured in the laboratory with a bridge. In order to describe a transient, the effects of both the switch and the load must be simultaneously considered. Certain assumptions were made concerning the switch, namely, that the switch is an ideal device and that certain phenomena associated with it (such as arcing, bouncing, and showering) would not be considered in a general mathematical model. Actually, the assumption of an ideal switch yields results that are greater than those voltages empirically measured, but this provides a safety factor in the analysis since a worst case condition is predicted. Author

N65-25184# United Kingdom Atomic Energy Authority, Harwell (England). Electronics Div.

A NON-FEDBACK AMPLIFIER SYSTEM YIELDING HIGH GAIN STABILITY

M. O. Deighton Dec. 1964 13 p ref.
(AERE-R-4777) HMSO: 2s 6d

A redundant arrangement of two amplifiers, which continues to operate even when either one of the amplifiers has failed, is analyzed theoretically in the case where both amplifiers are operative. It is shown that the overall stability and linearity of gain is then considerably superior to that of either amplifier individually. The system thus appears to offer some of the advantages of negative feedback, but without the stability problems associated with a closed loop. The high-frequency and transient responses of the combination are examined in detail; it is found that the latter generally exhibits overshoot, but may be corrected by a suitable output network. A brief appraisal of the noise performance of the system suggests that noise arises chiefly in one of the two amplifiers, the performance of the other being much less critical. Author

N65-25194# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.

SIMULATION OF FEEDBACK CONTROL SYSTEMS BY DIGITAL METHODS

Fred G. Ehler and Margaret L. Tindle 17 Feb. 1965 94 p refs
(Contract DA-36-039-AMC-03404(E))
(EDL-M759; AD-462854)

The use of time-domain matrix methods in digital simulation of linear time-invariant feedback control systems is described. With this method it is no longer necessary to evaluate the system characteristic roots. In addition, the method may be easily extended to more complicated systems such as nonlinear and time-varying systems. The use of this technique in the simulation of a ballistic missile yaw guidance loop is described, and the results are compared for two types of guidance commands. Author

N65-25267*# Connecticut Univ., Storrs. Dept. of Electrical Engineering

COMMENTS ON SYNTHESIS TECHNIQUES EMPLOYING THE DIRECT METHOD

Richard V. Monopoli 3 May 1965 7 p refs
(Grant NsG-309-S3)
(NASA-CR-63152) CFSTI: HC $1.00/MF $0.50

The validity of conclusions reached using a continuous rather than a discontinuous sign function as a control signal is investigated. Emphasis was placed on the stability in the region where the saturation function has a smaller magnitude than the theoretically specified sign function. The problem was examined with relation to the synthesis technique employing a model reference for control of single input and output, linear time-varying plants with parameters varying in an unknown manner within known, finite bounds. R.W.H.

N65-25287# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

DISTRIBUTION THEORY AS THE BASIS OF GENERALIZED PASSIVE-NETWORK ANALYSIS

M. R. Wohlers and E. J. Beltrami Dec. 1964 26 p refs
(RE-198J)

The properties of linear, time-invariant, passive systems are described in the context of generalized function (distribution) theory. The postulatory description of these systems is phrased in both the scattering or wave formulation, and the impedance or voltage-current basis. One conclusion is that a specific definition of passivity leads to a complete description of the system only when the postulate of causality is separately invoked; i.e., this definition of passivity does not imply causality and it is therefore a more fundamental assumption. Another conclusion is that the two seemingly different sets of postulates (scattering and impedance) are in many instances identical; the differences arise solely in the assumptions made concerning the domains of the two operators. Distribution theory is also used in an essential way to obtain new existence theorems, for both formulations, which are stated entirely on the real-frequency axis ($p = j\omega$). The language is that of generalized function theory, so that the class of admissible systems and the inputs to these systems are broadened. The results are particularly applicable to systems described in terms of elementary functions. Author

N65-25361# National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.

MIXER GENERATION OF AUDIO SINE WAVES OF CONSTANT PHASE ANGLE DIFFERENCE

D. Layton and K. A. Steele [1962] 9 p Repr. from Div. Paper No. EIC-63-CE&A 14, v. 1, no. 32 of the Eng. Inst. of Canada
(NRC-7722)

The mixer principle is applied to a low frequency sinusoidal generator to obtain two signals with a relative phase difference that remains fixed over the instrument's frequency range. The generator was designed for use as a stroboscope trigger for illuminating an object undergoing vibration testing by a mechanical shaker, but can also be used for measuring gain and phase shift characteristics of amplifiers and servo systems, and for obtaining a time delay inversely proportional to frequency over a broad bandwidth. The generator is basically a two-channel beat frequency oscillator. The first channel is conventional and the second includes a resolver rotor between the fixed oscillator and mixer. This can be positioned for any desired phase difference between the generator outputs, or rotated continuously to obtain a continuous relative phase change or frequency difference between the two outputs. The circuit is described and performance characteristics are discussed. A schematic drawing of the phase shifter and graphs of phase deviation characteristics are included. R.N.A.

N65-25388# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

SINGULAR LINEAR SEQUENTIAL MACHINES: SOME FURTHER GROUP PROPERTIES AND CANONICAL FORM REALIZATIONS

Pierre Lavallee 12 Oct. 1964 20 p refs
(Contract AF 49(638)-1402)
(PIBMRI-1250-64; AD-612642)

Singular autonomous linear sequential machines are analyzed following simple group properties. It is shown that the set of junction states for the confluence sets form a group, with as normal subgroup, the sets of states on the cycle sets. The set of states mapping into the null (0) state also forms a group called the null tree group. The cycle set group and the null tree group are realized separately and the direct sum

of these two groups completely characterizes the operation of the machine. The null tree is shown to be characterized by a set of m disjoint paths: to each of these paths there corresponds a shift register having as many delay elements as there are states in that path. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N65-24576# ARO, Inc., Arnold Air Force Station, Tenn.
DEVELOPMENTAL EVALUATION OF NEAR 17°K MOLECULAR SIEVE 5A FOR HYDROGEN CRYOSORPTION
R. E. Southerlan. Arnold Eng. Develop. Center, Apr. 1965. 32 p. refs
(Contract AF 40(600)-1000)
(AEDC-TR-65-48, AD-462206)

Test results are presented for the cryosorption of hydrogen on a commercially manufactured molecular sieve 5A panel operated near 20° K. Effects of repeated activations, water and air contamination under vacuum, and exposure to atmospheric conditions were observed. Using suitable operating techniques, pumping speeds near theoretical maximums were obtained. Author

N65-24579# Aberdeen Proving Ground, Md. Terminal Ballistics Lab.
SHOCK PRESSURE INCREASE IN CONVERGENT DUCTS
George A. Coulter. Jan. 1965. 46 p. refs
(BRL-MR-1625; AD-461336)

Pressure–time histories obtained from piezoelectric transducers are shown for shock waves inside various shaped convergent ducts. The convergent ducts used ranged from an area ratio of 22 for the discontinuous area change to 8149 for a conical duct with an included angle of 15°. The step input shock pressure ratio was varied from 1.6 to about 28. A maximum peak reflected shock pressure of over 11 000 psi was recorded for the large conical area change. Results, presented in both tabular and graphical form for the various ducts used, show that the corresponding increase in peak pressure is found to vary with the shape of the convergent duct and with the area change ratio. Author

N65-24718*# Northrop Space Labs., Hawthorne, Calif.
APOLLO DOCKING TEST DEVICE DESIGN STUDY Final Report
William J. Gaugh and V. W. Howard. Dec. 1964. 240 p. refs
(Contract NAS9-3717)
(NASA-CR-65014; NSL-64-360) CFSTI: HC $6.00/MF $1.25

The docking simulator system intended for use in confirming the design of the Apollo probe and drogue docking mechanisms under simulated space conditions is described. Included are data on the concept, operation, performance, and other ancillary requirements; and a discussion of structural dynamics, thermal effects, and mounting probe drogue mechanisms. The relationships of the system with regard to the space simulation chamber are discussed in terms of vibration isolation, chamber penetration, safety, and equipment installation and removal requirements. The design evolution and characteristics of the mounting structure are presented along with sketches, drawings, and a photograph of a 20th-scale model. The system concept developed was determined to be feasible and within the current state of the art. Data on an analog computer program, fuel sloshing, hydraulic fluids, and elastic structural dynamics are included. S.C.W.

N65-24884 Joint Publications Research Service, Washington, D. C.
A NEW TOOL FOR SCIENTIFIC RESEARCH—SHOCK TUBE
Fu Chin and Hung Ju *In its* Transl. on Communist China's Sci. and Technol., No. 181, 25 May 1965, p 28–32. Transl. into ENGLISH from K'o-hsueh Ta-chung (China), no. 3, Mar. 1965, p 38–39 (See N65-24879 14-34) CFSTI: $3.00

The shock tube and some of its uses in scientific research are reviewed. The tube itself, its high- and low-pressure chambers and the dead end chamber which absorbs refracted waves, are described in detail. The shock tube was first used to evaluate high speed pressure gages. Tubes can be designed as shock wave wind tunnels which create air currents with speeds 20 times that of sound, for study of rockets and guided missiles. Electromagnetic shock tubes can produce extremely high temperatures useful in studying problems of controllable thermonuclear reactions. The shock tube is a powerful tool for investigation of ionization processes. When shock tubes are employed to elevate the temperature of methane rapidly to 1500° C, followed by immediate cooling, acetylene can be recovered. J.M.D.

N65-24919 National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board
NASA TRACKING AND DATA ACQUISITION SYSTEM: NEW DEVELOPMENTS
In its U.S. Space Sci. Program, Rept. to COSPAR, 1963, p 113–115 (See N65-24908 14-30)

The 27 NASA overseas tracking and data acquisition centers are categorized: there are 8 Minitrack stations which focus on unmanned scientific satellites, 9 optical tracking centers with telescopic cameras which provide backup for the ground radio stations and precise data for atmospheric drag and geodetic studies, 2 Deep Space Instrumentation Facilities equipped with transmitters and receivers to maintain contact with spacecraft traveling to the moon and beyond, and 8 ground stations in the Manned Space Flight network for satellite tracking and data handling. The paraboloid reflector antennas with 26 meters aperture, currently used in Deep Space Network (DSN) for contact with spacecraft, are described. Plans to improve the capacity of DSN satellite communications are indicated, which include a new antenna 64 meters in diameter. J.M.D.

N65-24946 Aeronautical Research Council (Gt. Brit.)
PROPOSALS FOR AN INTEGRATED WIND TUNNEL-FLIGHT DYNAMICS SIMULATOR SYSTEM
L. J. Beecham, W. L. Walters, and D. W. Partridge. London, HMSO, 1965. 43 p. refs. Supersedes RAE-TN-AERO-2852, ARC-24681
(ARC-CP-789) HMSO: 10s 6d

A design is considered in which the wind tunnel is an integral part of a system suitable for the simulation of the behavior of aircraft and missiles in flight. The static aerodynamic loads on a wind tunnel model, mounted on a conventional quadrant support, are measured and combined with continuously computed gravitational, inertial, and aerodynamic damping loads, the model orientation to the flight path being correctly maintained throughout. The computer elements comprise a small analog unit for the on-line correction of the wind tunnel data, and a D.D.A. unit consisting of CORSAIRs for the kinematic simulation and wind tunnel control. Author

N65-25014 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
A CRYSTAL-GROWING FURNACE
J. Rolfe *In its* Bull. of the Radio and Elec. Eng. Div., V. 14, No. 3, Jul.–Sep. 1964 [1964] p 1–3 (See N65-25013 14-07)

A new crystal-growing furnace for growing alkali halide crystals has been put into operation. While based on the principles used in the design of the first furnace, many minor faults have been eliminated. Author

N65-25015 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
A DIFFERENTIAL GETTER PUMP
E. V. Kornelsen *In its* Bull. of the Radio and Elec. Eng. Div., V. 14, No. 3, Jul.–Sep. 1964 [1964] p 3–6 refs (See N65-25013 14-07)

The use of a differential pumping stage, for nitrogen pressure ratio measurements, which allowed a high vacuum system ($p \leq 10^{-9}$ torr) to be connected to an ultrahigh-vacuum system ($p \leq 10^{-9}$ torr) in such a way as to permit an ion beam to be transmitted from the one into the other, is reported. The stage, which was of Pyrex glass, consisted of two short cylindrical tubes separated by a spherical getter volume V_1, the entire assembly joining together two vacuum systems at pressures P_1 and P_2 ($P_1 > P_2$). Results show that the pump gave the best performance theoretically possible in that it allowed the transmission of only those nitrogen molecules which passed directly from tube one through tube two. The capacity of the getter surface laid down in a single evaporation was such that lifetimes of the order of 1 hour result for easily attainable values of P_1 (10^{-5} torr). In a second experiment it was demonstrated that at least 300 such evaporations could be obtained from a single getter loop. Schematic diagrams of the differential getter pump and the ultrahigh vacuum system, which was used for differential pump measurements, are included. S.C.W.

N65-25077 Bell Aerosystems Co., Tucson, Ariz. Research Lab.
ARMY ENVIRONMENTAL DATA COLLECTION AND PROCESSING FACILITY
R. D. Larson *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 15–27 (See N65-25075 14-07)
(Contract DA-44-196-AMC-00041(E))

The overall responsibilities and task status of the Environmental Data Collection and Processing Facility are briefly described, and the progress being made in applying computer techniques to the frequency allocation mission and to the preparation of tactical Army environments for analysis by the Department of Defense Electromagnetic Compatibility Analysis Center and the Army Electromagnetic Environmental Test Facility is detailed. Author

N65-25083 Naval Air Test Center, Patuxent River, Md.
FACILITIES AND TECHNIQUES FOR THE ANALYSIS OF ELECTROMAGNETIC COMPATIBILITY AND SUSCEPTIBILITY OF NAVAL AIRCRAFT WEAPONS SYSTEMS
J. V. Le Fort and R. S. Pugh *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electrromagnetic Compatibility [1964] p 131–150 refs (See N65-25075 14-07)

The test facility consists of an interference test laboratory (shielded hangar) capable of housing the largest aircraft. The controlled laboratory provides very low ambient electromagnetic fields which affords precise compatibility analysis. For the environmental tests, electromagnetic fields are generated and contained within the controlled area. Analyses are in conformance with applicable specifications which are supplemented with current state-of-the-art techniques. Many new and complex weapons systems were created with resultant solid-state devices, i.e., computers, etc., and receivers having exceedingly high respective susceptibilities and sensitivities which require simultaneous operation with communication systems, data systems, and radars of high intensity rf power output. The need of controlled areas and improved techniques for precision analysis of these weapons systems to provide valid results and corrective applications has become increasingly important. Author

N65-25155# United Kingdom Atomic Energy Authority, Risley (England). Safeguards Div.
CHEMICAL PLANTS AND LABORATORIES: THE PREPARATION OF A SAFETY DOCUMENT
1965 11 p
(AHSB(S) R-79)

The preparation of safety documents for new or existing chemical plants and laboratories is presented, and the results of the analysis of fail-to-fault danger safeguards are given. Among hazards and safeguards mentioned are external radiation, radioactive contamination of the environment criticality, fire and explosion, general industrial and chemical hazards, authority health and safety codes, ionizing radiations, and chemical and electrical regulations. It is suggested that the disposal of liquid or solid radioactive wastes from a plant or laboratory be handled by a central facility for the site. The safety document should define the information required, state how the operator proposes to obtain it, and demonstrate that the facility can be operated safely. R.W.H.

N65-25326# European Space Research Organization, Paris (France). Control Centre Div.
CONTROL CENTRES FOR UNMANNED SCIENTIFIC SPACECRAFT
G. C. Tootill Nov. 1963 25 p refs
(ESTec-1)

The control center handles the network of tracking and telemetry stations and the management of the satellites in orbit. This involves (1) forecasting the position in orbit after obtaining the necessary data; (2) scheduling the work of the stations and directing the stations accordingly; (3) assessing spacecraft performance and transmitting commands to the spacecraft; and (4) assembling tracking and telemetry data and sending it to the organization that will use it. Detailed descriptions of how these tasks are performed at the Goddard Space Flight Center are presented. G.G.

N65-25339# Joint Publications Research Service, Washington, D. C.
RESEARCH LABORATORIES ON AEROSPACE IN JAPAN
8 Jun. 1965 42 p Transl. into ENGLISH from the publ. "Koku Uchu Nenkan" (Tokyo), 30 Jul. 1964 p 215–230
(JPRS-30502; TT-65-31213)

A synopsis of aeronautical research laboratories in Japan is presented. Cited are facilities engaged in research in the areas of transonic and supersonic aircraft, V/STOL aircraft, and rocketry. Discussed are major research projects conducted by the Agency of Science and Technology, and the Institute of Industrial Science and the Institute of Space and Aeronautical Science of Tokyo University. Among the projects cited are research in instrumentation, fluid dynamics, wind tunnel construction, polymer material engineering, structural dynamics, telemetering engineering, missile structures, radar systems, and telemetry. S.C.W.

N65-25358# Republic Aviation Corp., Farmingdale, N. Y.
LONGSHOT I HYPERSONIC FREE-PISTON TUNNEL
J. Christopher Boison May 1965 61 p refs Revised
(RAC-1884A; SMSD-TR-65-4)

This report presents a complete description of a free-piston cycle hypersonic tunnel. Mechanical aspects as well as the free-piston cycle process are discussed. Instrumentation used and data acquisition and processing techniques are described. Examples of actual data obtained are included.
Author

N65-25366# European Space Research Organization, Paris (France).
THERMAL ENVIRONMENT SIMULATION
L. A. Husain [1964] 20 p refs Presented at the European Space Research Organization Summer School, Oxford, 31 Aug. 1964

Methods of achieving various requirements in the laboratory are discussed together with techniques and instrumentation employed. Some possible solutions are reviewed. Author

N65-25411# Army Dept., Washington, D. C.
ARMY AIRFIELD–HELIPORT DESIGN: GENERAL PROVISIONS AND CRITERIA
15 Apr. 1965 62 p Supersedes EM-1110-3-311
(TM-5-823-1; EM-1110-3-311)

The general provisions and criteria for planning the configuration, including navigable airspace and clearances, and the design of pavements for airfields and heliports at Army installations are prescribed. E.E.B.

N65-25437# Air Products and Chemicals, Inc., Allentown, Pa. Research and Development Dept.
ENERGY DEPOT CRYOGENIC FUEL STORAGE AND DISTRIBUTION SYSTEM. PHASE I: CONCEPTUAL DESIGN STUDY (U) Quarterly Progress Report No. 2, Jul.–Sep., 1963
R. G. Clark, E. M. Flounders, and P. D. Stelts Oct. 1963 27 p refs
(Contract AT(30-1)-3129)
(APCI-541102) (Declassified)

Progress is reported on the design, development, and construction of a cryogenic fuel storage and distribution system. Materials were procured for the outer shell aluminum-honeycomb cylindrical section, the outer shell cylinder heads, the inner shell for the lightweight 50-gallon test vessel, and the multiple radiation shield insulation for the boiler plate and lightweight 50-gallon test vessels. Tests for identifying a satisfactory aluminum-to-steel welding transition piece and for selecting an inner vessel material are progressing. The 50-gallon boiler plate test vessel is being fabricated. The instrumented test stand is near completion and the testing program established. The 50-gallon lightweight test vessel design has progressed and materials are being ordered. R.N.A.

N65-25466# Allis-Chalmers Mfg. Co., Milwaukee, Wis. Atomic Energy Div.
ENERGY DEPOT SYSTEM STUDY, LIQUID HYDROGEN AND AMMONIA FUELS
Feb. 1964 241 p refs Prepared jointly with Air Products and Chemicals, Inc., Allentown, Pa.
(Contract AT(30-1)-3133)
(ACNP-64501) (Declassified)

Three separate energy depot systems are investigated: liquid hydrogen–air, liquid hydrogen–liquid oxygen, and ammonia–air. These fuel production plants (energy depots) are comparable in all cases. Liquid hydrogen is most efficient; ammonia, smallest and lightest. Fuel storage and handling units are feasible for all, with a small advantage for storing ammonia under pressure. Application of fuel cell drives to an armored personnel carrier and a 5-ton cargo truck are studied; and, the fuel cells, their auxiliaries, and the electric drive motor are described. The effect on the two vehicles using the energy depot fuels with the fuel-cell drive unit is analyzed. Of the three, the hydrogen–air fuel-cell drive unit produces the lightest, most promising vehicle. The vehicle characteristics are also analyzed when powered by an internal-combustion engine using liquid hydrogen, or ammonia as fuel and are compared with fuel cell powered vehicles. When an internal-combustion engine is used, ammonia is the better fuel. Author

N65-25467# Air Products and Chemicals, Inc., Allentown, Pa. Research and Development Dept.
ENERGY DEPOT CRYOGENIC FUEL STORAGE AND DISTRIBUTION SYSTEM. PHASE I: CONCEPTUAL DESIGN STUDY (U) Quarterly Progress Report No. 1
R. G. Clark, E. M. Flounders, and P. D. Stelts Jul. 1963 118 p refs
(Contract AT(30-1)-3029)
(APCI-541101) Declassified

Selection of vessel materials and designs was completed. Analysis of the thermodynamics of liquid hydrogen storage is presented with its results in charts which illustrate relationships among initial volume fraction of liquid at filling, total quantity of heat added to the fluid, total mass fraction of the fluid vented, and venting pressure. Temperature stratification within the liquid hydrogen and maintenance of a high-vacuum insulation for a long time are discussed. A reference vessel design established was used as the basis for analysis and evaluation of candidate designs and materials. This study resulted in the preliminary selection of materials and vessel design concepts which will yield the lightweight, rugged vessels envisioned for energy depot use. Graphs showing anticipated tankage weights, volumes, and boiloff characteristics for the advanced vessels are presented. Uncl. Author

N65-25526# Radio Corp. of America, Moorestown, N. J. Missile and Surface Radar Div.
DESIGN OF A HIGH-ENERGY FAST-PULSE POWER SYSTEM, PHASE II Technical Documentary Report, Jun. 1963–Jun. 1964
C. A. Nittrouer Kirtland AFB, N. Mex., AF Weapons Lab., Mar. 1965 249 p refs
(Contract AF 29(601)-6035)
(WL-TDR-64-94; AD-613959)

A comprehensive three-part (analytical, experimental, and design) program for development of a high-energy, fast-pulse power system to be used for simulation of certain aspects of high-altitude, nuclear detonations is described. The objectives were (1) design and cost estimates of the system, and (2) analytical and experimental studies regarding operation of such a system. Design for a practical system has resulted, and conclusions from the experimental and theoretical studies show what may be expected in regard to output radiation dose rates relative to discharge of the system stored electrical energy.
Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N65-24429# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
SEPARATED FLOW STUDIES AT HYPERSONIC SPEEDS. PART II: TWO-DIMENSIONAL WEDGE SEPARATED FLOW STUDIES

Michael Holden Dec. 1964 70 p refs
(Contract Nonr-2653(00))
(CAL-AF-1285-A-13(2); AD-613463)

To obtain information on separation and reattachment of a laminar boundary layer, measurements were made in air at free stream Mach 10 and Reynolds number $1.35 \times 10^{+5}$/inch, in regions of adverse pressure gradient and moderately separated flow induced by forward facing wedges and externally generated shocks. Flow patterns and heat transfer distributions were also measured in large separated regions induced by forward facing wedges to investigate mechanism of reattachment heating. Parameters varied were reattachment angle, boundary layer thickness at separation and distance from reattachment point to expansion at wedge top. Reattachment heat transfer rates were found dependent on reattachment angle; for configurations tested there was little influence of boundary layer thickness or downstream expansion on heat transfer generated in reattachment region. Measurements were correlated in terms of viscous interaction parameters $M^3 C_H$ and $\bar{\tau}$ and compared with calculations based on simple models for the separated flow field. Author

N65-24431# Iowa Inst. of Hydraulic Research, Iowa City.
FREE-SURFACE EFFECTS ON TURBULENT-BOUNDARY-LAYER SEPARATION
Shin-Kien Chow Mar. 1965 70 p refs
(Contract Nonr-1611(01))
(AD-613372)

An experimental investigation of free-surface effects on turbulent-boundary-layer separation is described. It consists of two parts: First, the experiment was carried out in a towing tank. A hydrofoil was towed at various velocities and depths, and the separation points and the piezometric-head distributions on the upper surface of the hydrofoil were measured. When the flow over the hydrofoil was subcritical, separation always occurred on its after part; when supercritical, separation was rapidly reduced and eliminated; when the water-surface disturbance was small, the shallower the depth of submergence of the hydrofoil the greater the possibility of separation occurrence; when the water-surface deformation was large, the shallower the depth the less the possibility of separation. Secondly, the experiment was carried out in a horizontal water flume. Three stationary, vertical struts were used. Separation occurred at the free surface near the trailing edge of these forms except at high velocities. The nondimensional piezometric-head distribution at the free surface was different from that at great depth. Near the trailing edge of a 30-inch strut, below the free surface but in proximity to it, there existed another separation zone which is believed caused by the secondary flow within the boundary layer induced by the surface waves. Author

N65-24442# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
MEASUREMENT OF BASE PRESSURE IN FREE FLIGHT
G. I. Mishin Mar. 1965 9 p ref Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 6, 1963 p 116-118
(RSIC-396)

The dependency of base pressure on Mach Number M in cylindrical bodies with hemispherical ends was investigated on a modern ballistic projectile in the range of 1.32 to 2.91 M, with Reynolds numbers changing proportionately to the velocity from $0.9 \cdot 10^6$ to $2.0 \cdot 10^6$. Vacuum chamber calibration consisted of taking photographs of flexure contour of the diaphragm in the bottom of the projectile to obtain the dependency of rubber flexure on the difference of atmospheric pressure and chamber pressure. The experiments gave a series of shaded photographs of the projectile along its trajectory in two perpendicular planes, making it possible to determine the angle of attack. With large attack angles, a change in the overflow geometry was observed in the projectile: separation of flow occurred on the lateral surface and not on the base of the projectile and was accompanied by great increase in back pressure. This method of measurement is sensitive enough for investigating the influence of specific heat on the coefficient of resistance. R.C.S.

N65-24468# Stanford Univ., Calif. Dept. of Mathematics
SCATTERING OF SURFACE WAVES BY A SUBMERGED CIRCULAR CYLINDER
Harold Levine 20 Nov. 1964 44 p refs
(Contract Nonr-224(74))
(TR-3; AD-608590)

The effect of a rigid circular cylinder, wholly immersed within and lying parallel to the free surface of an incompressible and inviscid fluid, on straight-crested surface waves passing overhead is investigated. A mode of analysis is developed, on the hypotheses of small amplitude and time-periodic fluid motions, that encompasses all directions of incidence of the primary wave; and it is used to extend results previously obtained in the case of normal incidence. It is shown, in particular, that the absence of surface wave reflection at normal incidence gives way to a partial reflection for other primary directions, which in turn verges on completeness as the direction of the incoming wave becomes more closely alined with that of the cylinder axis. Author

N65-24524*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
THE RELATION BETWEEN SKIN FRICTION AND HEAT TRANSFER FOR THE COMPRESSIBLE TURBULENT BOUNDARY LAYER WITH GAS INJECTION
C. C. Pappas and Arthur F. Okuno Washington, NASA, Jun. 1965 31 p refs
(NASA-TN-D-2857) CFSTI: HC $2.00/MF $0.50

Average Stanton numbers and recovery factors of turbulent boundary layer with gas injection of helium, air, and Freon-12 are presented for airflow over a sharp cone at cone Mach 0.7, 3.67, and 4.35 and Reynolds numbers near 2.5 million. Relative effectiveness of injection gases in reducing the heat-transfer coefficient agrees with theory and with previous local measurements. Effect of Mach number on reduction of Stanton number from its zero injection value is not so great as its effect on reduction in skin friction. For Mach 0.7, the recovery factor for air and Freon injection generally decreases with increased injection; for helium injection, the recovery factor rises to a maximum 1.25, then decreases at higher rates of injection. For supersonic Mach numbers, recovery factor initially decreases with injection of each gas then rises to values that can exceed 1.0 at the highest injection rates. The ratio of average Stanton number to one-half the skin-friction coefficient, designated here as Reynolds analogy factor, was determined over the range of experimental variables. For subsonic flow, initial trends in values of the Reynolds analogy factor parallel helium and air injection. With Freon injection the experimental factor is constant but the theoretical values increase linearly with injection. For supersonic flow, with air injection, theoretical values of Reynolds analogy factor increase linearly with injection and experimental values decrease with injection. With helium injection, Reynolds analogy factor increases initially to a maximum near 1.35, then drops to near 0.55 at high injection rates. With Freon injection there is the least variation in Reynolds analogy factor of injection gases tested; values generally decrease from 1.1 to near 0.77 at the high rates of injection. Author

N65-24560*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INVESTIGATION OF EFFECTS OF RAMP SPAN AND DEFLECTION ANGLE ON LAMINAR BOUNDARY-LAYER SEPARATION AT MACH 10.03
Lawrence E. Putnam Washington, NASA, May 1965 36 p refs
(NASA-TN-D-2833) CFSTI: HC $2.00/MF $0.50

An investigation was made in the 15-inch hypersonic flow apparatus to establish the extent and magnitude of the separation-induced pressure distribution on flat surfaces ahead of small-span ramps and to evaluate the usefulness of two-dimensional separation theory for correlating and predicting the characteristics of laminar separation in three-dimensional flow. Pressure distributions were obtained on a flat plate with an aft-mounted ramp at Mach 10.03 and Reynolds numbers per inch of approximately 1.27×10^5 and 1.53×10^5. The experimental results indicate that increasing the deflection angle of a finite-span ramp from 10° to 40° results in increases in the length of the separated region along the model center line and in the magnitude of the pressures in the separated region. Decreasing the ramp aspect ratio from 4 to 2 at a given deflection angle results in decreases in the magnitude of the pressures in the separated region. Data for the ramps of aspect ratio 2 and oil-flow observations indicate that the separation-induced pressure rise extends a considerable distance outboard of the lateral edge of the finite-span ramps. Author

N65-24577# ARO, Inc., Arnold Air Force Station, Tenn.
BOUNDARY-LAYER TRANSITION UNDER HYPERSONIC CONDITIONS
J. Leith Potter and Jack D. Whitfield Arnold Eng. Develop. Center, May 1965 62 p refs Presented at the Specialists' Meeting on Recent Develop. in Boundary Layer Res., Naples, 14 May 1965
(Contract AF 40(600)-1000)
(AEDC-TR-65-99; AGARDograph-67, Pt. III; AD-462716)

Hypersonic conditions are considered, and data presented correspond to free-stream Mach numbers up to 18. However, the greater part of the data correspond to local Mach numbers, M_δ, below 8.5. Results indicate the tendency for Reynolds number of transition to increase with Mach number (all else equal and $M_\delta > 3$) continues at least to $M_\delta = 8.5$ on both sharp-nosed cones and plates. The more stable boundary-layer flow on cones than on plates, demonstrated experimentally for $M_\delta \approx 3$, remains in evidence but appears diminished when M_δ increases toward 8.5. Defining local flow conditions for boundary-layer analysis on slightly blunted bodies is emphasized. New data showing the size of roughness necessary to trip laminar boundary layers with M_δ up to 8.5 are incorporated in an earlier correlation. Laminar- and turbulent-flow theories are compared with corresponding experimental data. Data presented indicate a boundary layer which appears to have been tripped by roughness according to both appearance in shadowgraphs and changed thickness, actually may not cause heat-transfer rate to rise to the level of fully turbulent flow. Author

N65-24585# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ENGINEERING JOURNAL Selected Articles
13 Jun. 1963 31 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), v. 1, no. 4, 1961 p 18–26, 51–58
(FTD-TT-63-388/1+2; AD-410934)

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1. AERODYNAMIC CHARACTERISTICS OF WINGS IN A SUPERSONIC FLOW IN PRESENCE OF SLIPPING Yu. I. Krasil'nikov p 1–10 refs (See N65-24588 14-01)

2. PROBLEM OF CALCULATING A TURBULENT STREAM WITH VERY HIGH TEMPERATURE V. A. Golubev p 11–22 refs (See N65-24587 14-12)

N65-24587 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEM OF CALCULATING A TURBULENT STREAM WITH VERY HIGH TEMPERATURE
V. A. Golubev *In its* Eng. J. 13 Jun. 1963 p 11–22 refs (See N65-24585 14-12)

A solution is given to the problem of plane-parallel stream of compressible gas (initial section) by Prandtl's theory of free turbulence on the assumption that the length of the mixing path for heat transfer is twice that for the transfer of a quantity of motion. Results of this theory are compared with those of Taylor's theory of free turbulence, in which the lengths of the mixing paths for the transfer of vorticity and heat were assumed identical. It was shown that the solution of the problem by Taylor's turbulence theory leads to contradictory results; on one boundary of the stream turbulent friction intensity is not equal to zero, as previously indicated. Experimental results are listed. Author

N65-24596*# AVCO-Everett Research Lab., Everett, Mass.
A BIMODAL APPROXIMATION FOR REACTING TURBULENT FLOWS. I: DESCRIPTION OF THE MODEL
Shao-Chi Lin (California Univ., San Diego) [1965] 15 p refs (Contracts AF 04(694)-414; DA-19-020-AMC-0210; Proj. Defender)
(AROD-5133; AD-456142)

An approximate method is proposed for calculating the rates of chemical reactions and of dissipation of mean-square fluctuations of chemical species in turbulent flow fields with large scale initial inhomogeneities under certain restrictive conditions. The method consists of dividing in a statistical sense any initially identifiable fluid element into two distinct volume fractions: fraction ω which survives the viscous dissipation or diffusive smearing process, and another fraction $(1-\omega)$ which does not. The Lagrangian time history for the chemical reactions in the volume fraction ω is assumed identical to that in an inviscid streamtube flow in spite of the convective distortions. The chemical reaction history for the remaining fraction $(1-\omega)$ is to be determined by the local reaction rates in a homogeneous mixture of all the neighboring fluid elements which have suffered viscous dissipation. The effects of turbulent transport of both the dissipated and undissipated fractions are represented by the same known function involving the initial coordinates of the fluid element. Author

N65-24600# Hydronautics, Inc., Laurel, Md.
SUPERCAVITATING FLOWS—SMALL PERTURBATION THEORY
Marshall P. Tulin 5 Sep. 1963 81 p refs
(Contract Nonr-3435(00))
(TR-121-3; AD-425710)

This paper outlines events leading to the formulation of linearized theory and indicates its scope. New analytical results presented include logical development of the linearized theory of steady supercavitating flows; presentation of a general solution for the linearized problem; introduction of a new nonlinear model for finite cavity flows; formulation of a simple second-order theory, and its application to the case of flat plates and symmetric wedges. Some old analytical results are also presented; they refer particularly to hydrofoil–airfoil equivalence and related results; and also to problems involving hydrofoils operating at high speeds beneath (hydrofoil boats) and over (supercavitating propeller sections) free surfaces. Author

N65-24607# Weapons Research Establishment, (Australia).
AN EXAMINATION OF THE FLOW INSTABILITY ASSOCIATED WITH SPIKED BLUFF BODY CONFIGURATIONS
M. L. Robinson, B. G. Roberts, and A. M. Sayer. Dec. 1964 39 p refs
(HSA-101)

Flow stability characteristics of spiked bluff body configurations were studied, in Mach range 1.6 to 2.8, as part of an investigation to examine an oscillatory flow regime observed with supersonic parachute configurations. Effects of Mach number, spike extension and spike geometry on the boundaries of flow stability and on the characteristics of the unsteady forces were examined for a simple body consisting of a right circular cylinder fitted with a retractable spike. In the most severe condition of flow instability the instantaneous drag of the cylinder oscillated between approximately 40% and 180% of the mean drag. The frequency of the flow oscillation ranged from 1 to 2.5 kc/s for the 2-in. diameter cylinder used in the tests. Author

N65-24641# Pisa Univ. (Italy). Inst. of Applied Mechanics and Aeronautics
STUDY OF AN AXIAL SUPERSONIC JET IN SUPERSONIC FLOW ' [STUDIO DI UN GETTO SUPERSONICO ASSIALE IN CORRENTE SUPERSONICA]
Marino Marini. 1964 28 p refs In ITALIAN *Its* 21st Ser., No. 1045

Using linear theory for a supersonic stream, a supersonic axial gas jet imbedded in a supersonic stream is studied. Distributions of supersonic sources are used for determining the characteristics of the current external to the jet and the distribution of particular singularities, or pseudo sources.
Transl. by P.F.E.

N65-24642# Pisa Univ. (Italy). Inst. of Applied Mechanics and Aeronautics
ON THE INTERFERENCE BETWEEN AN AXIAL SUPERSONIC JET AND SURFACES IN A SUPERSONIC STREAM [SULLA INTERFERENZA TRA UN GETTO SUPERSONICO ASSIALE E SUPERFICI AD ESSO PROSSIME IN UNA CORRENTE SUPERSONICA]
Marino Marini. 1964 10 p refs In ITALIAN *Its* 21st Ser., No. 1046

The problem of interference between a supersonic gas jet and a flat plate placed in a supersonic stream at a finite distance from the exhaust is examined. Calculations for pressure distribution on the plate are given. Transl. by P.F.E.

N65-24643# Pisa Univ. (Italy). Inst. of Applied Mechanics and Aeronautics
STUDY OF A SUPERSONIC JET AT ZERO INCIDENCE IN A SUPERSONIC STREAM [STUDIO DI UN GETTO SUPERSONICO DISPOSITO AD INCIDENZA NON NULLA IN UNA CORRENTE SUPERSONICA]
Marino Marini. 1964 18 p refs In ITALIAN *Its* 21st Ser., No. 1047

A supersonic jet from a nozzle in a supersonic stream at zero incidence is examined. Calculations of the stream in and around the jet, based on distributions of supersonic singularities, are given. Transl. by P.F.E.

N65-24668*# National Aeronautics and Space Administration, Washington, D. C.
PRESERVATION OF THE MAXWELLIAN DISTRIBUTION FORM IN A RELAXING GAS [O SOKHRANENII FORMY MAKSVELLOVSKOGO RASPREDELENIYA V RELAKSIRUYUSHCHEM GAZE]
D. I. Osipov. Oct. 1961 6 p refs Transl. into ENGLISH from Vestn. Mosk. Univ. (Moscow), no. 1, 1961 p 13-15
(NASA-TT-F-8173) CFSTI: HC $1.00/MF $0.50

The process of Maxwellian equilibrium settling in a light gas surrounded by an atmosphere of heavy gas is being investigated. It is assumed that the interaction forces are inversely proportional to the fifth power of the distance. It is shown that the initial light-gas distribution being Maxwellian (with temperature differing from that of a heavy gas), the Maxwellian form of distribution in that gas will be preserved in the equilibrium settling process; only the temperature will change. The question of extending this result to other laws of interaction is also examined. Author

N65-24671*# National Aeronautics and Space Administration, Washington, D. C.
ON HYPERSONIC FLOWS OF A RAREFIED GAS [O GIPERZVUKOVYKH TECHENIYAKH RAZREZHENNOGO GAZA]
M. N. Kogan. Oct. 1962 22 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 26, 1962 p 520-529
(NASA-TT-F-8286) CFSTI: HC $1.00/MF $0.50

The basic theoretical concepts, the criteria, and the conditions for the existence of near-free-molecular hypersonic flows are discussed. Flow past a plate perpendicular to the direction of the flow is considered for various Mach numbers and collision cross sections. It is assumed that the reflection of molecules from the plate is diffusive with a Maxwellian velocity distribution. Flow past a plate at zero angle or at small angles of attack is examined. The phenomenon by which molecules are "torn" from the incident flow by reflected molecules and "transformed" into molecules of a new type is defined. It allows the computation of the flow, taking into account the first collisions even in cases when one of the characteristic path lengths is much smaller than the body's dimension. Author

N65-24673*# National Aeronautics and Space Administration, Washington, D. C.
ANALYSIS OF THE RESULTS OF SIMULTANEOUS MEASUREMENTS OF ELECTRON CONCENTRATION IN THE IONOSPHERE WITH THE HELP OF IONOSPHERIC STATIONS AND ROCKETS [ANALIZ REZUL'TATOV ODNOVREMENNYKH IZMERENIY ELEKTRONNOY KONTSENTRATSII V IONOSFERE S POMOSHCH'YU IONOSFERNYKH STANTSIY I RAKET]
Sep. 1962 13 p refs Transl. into ENGLISH from Iskusstv. Sputniki Zemli (Moscow), no. 13, 1962 p 89-96
(NASA-TT-F-8283) CFSTI: HC $1.00/MF $0.50

Comparison is made of rocket and ground-station measurements of electron concentration distribution in the ionosphere. Electron distribution, n_e (h), is computed on the basis of high-frequency characteristics and measurements by satellites. The reliability of rocket measurements is corroborated, and it is established that the computation of altitude distribution of electrons can be solved by the integral equation method using Shinn-Kelso coefficients. It is possible to accumulate data on n_e (h) variations with the time of the day and year. D.B.

N65-24750# Rocketdyne, Canoga Park, Calif. Research Dept.
A STUDY FOR DESIGN OF A FLOWMETER CALIBRATION SYSTEM CAPABLE OF THIXOTROPIC AND NEWTONIAN FLUID USE Final Report
T. B. Thomson, Jr. Edwards AFB, Calif., AF Rocket Propulsion Labs., Jan. 1965 65 p refs
(Contract AF 04(611)-9702)
(R-5938; AFRPL-TR-64-166; AD-461173)

Design criteria for a flowmeter calibration system capable of using thixotropic and liquid propellants are reviewed in light of their chemical and physical properties. System design is

described in terms of operation, accuracy, and safety precautions. Error analysis for the detector and sheer-stress characteristics of various types of liquids are presented. Author

N65-24778# Brown Univ., Providence, R. I. Div. of Engineering
AN ESTIMATE OF COMPRESSIBLE BOUNDARY LAYER DEVELOPMENT AROUND A CONVEX CORNER IN SUPERSONIC FLOW
B. L. Hunt and M. Sibulkin Nov. 1964 51 p refs
(Contract Nonr-562(35))
(AD-609975)

Effect of a sharp convex corner on the momentum thickness of a compressible, supersonic boundary layer flow is analyzed. The problem is attacked by a momentum integral technique in which an approximate pressure field is used. The shape factor is approximated by a simple expression which is also of general application. The main result of the analysis is an analytic expression for the ratio of the momentum thicknesses downstream and upstream of the corner. The results are also presented graphically over appropriate ranges of the major flow parameters. Author

N65-24826# Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
FURTHER STUDIES OF VENTILATED CAVITIES ON SUBMERGED BODIES
F. R. Schiebe and J. M. Wetzel Oct. 1964 63 p refs
(Contract Nonr-710(48))
(Rept.-72; AD-462959)

Reentrant jet, trailing vortex, and pulsating cavities were observed, to determine the air requirements of ventilated cavities on hydrofoils and other submerged bodies in the vicinity of a free surface. Primary attention was given to extending an analysis of the type reported by Cox and Clayden and later extended by Campbell and Hilborne for predicting the air requirements of trailing-vortex-type cavities and for obtaining pertinent experimental data. It was shown that good agreement with the experimental data was obtained by both theoretical and semiempirical expressions. Secondary attention was given to further verification of a correlation parameter previously derived for reentrant jet-type cavities. The transition region between reentrant jet and trailing vortex cavities was also investigated. For some conditions, pulsating cavities were found in the transition region. Author

N65-24830# MITHRAS, Inc., Cambridge, Mass.
NEAR FIELD INFRARED BACKGROUND NOISE SIMULATION Interim Engineering Report, Feb.–Oct. 1964
Richard H. Adams Jan. 1965 54 p refs
(Contract Nonr-3489(00))
(MC-61-5-R5; AD-462729)

Studies on the near-field infrared background noise problem were directed towards simulation of the infrared noise emanating from a known turbulent zone. A laboratory tool for simulating near field noise was designed, utilizing a simple heated round free subsonic jet as the infrared noise generator. A review of the characteristics of the hot free subsonic jet is presented and design of the simulator described. Preliminary measurements of the fluctuations in radiant emittance from the jet have been made with an ac radiometer. The data have been reduced to normalized spectral density curves. The spectral density curves exhibit a more rapid decrease in energy level with increasing frequency than do spectral density curves obtained from hot wire measurements. Finally, a brief literature survey was made of the infrared properties of CO_2 and H_2O in the 2.7μ region for small optical path lengths and elevated temperatures. Absorption data presented are especially applicable to laboratory experiments. Author

N65-24840# McGill Univ., Montreal (Quebec). Mechanical Engineering Research Labs.
SECONDARY FLUID INJECTION INTO A SUPERSONIC AIRSTREAM
Edward J. Szpiro Apr. 1965 97 p refs
(Grant DRB-G-9550-06)
(Rept.-65-2)

Simplified theoretical models are presented, based on Newtonian flow concepts, for the prediction of the injectant path, and hence the penetration distance for both gaseous (compressible) and liquid (incompressible) secondary injection into a supersonic stream. Experimentation shows that it is possible to achieve significant penetration distances (for spontaneous supersonic combustion) by injecting from a wall orifice. Experiments were performed for water injection into a Mach 3 supersonic airstream, for ranges of initial injection angle (28° upstream to 31° downstream), injector diameters (0.014 in. to 0.035 in.) and injectant total pressures (65 psia to 365 psia). The total number of different runs, from which results were obtained, was 105. The simplicity of the theory and the accuracy with which it agrees with the experiments favor the use of this approach for the theoretical prediction of penetration distances and paths for downstream and small angle upstream injection. Author

N65-24841# Aircraft Research Association, Ltd., Bedford (England).
CONTRIBUTION TO THE STUDY OF SUPERSONIC EJECTORS
Maurice Sirieix Mar. 1965 17 p Transl. into ENGLISH from FRENCH Presented at the Assoc. Tech. Maritime et Aeron., Paris, 27–30 May 1963
(ARA-LIB-TRANS-8)

The theoretical analysis of flow in a dual-flow ejector reveals different flow regimes, which are confirmed by experiment. The calculation of the discharge behavior for small secondary flows can be made by the use of fundamental studies of reattachment, using a slight modification of normal methods. The correlation of theory with experiment is quite satisfactory. Author

N65-24975*# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
THE DYADIC GREEN'S FUNCTION FOR AN INFINITE MOVING MEDIUM
R. T. Compton, Jr. and C. T. Tai 15 Jan. 1964 19 p refs *Its* Rept. 1691-3
(Grant NsG-448)
(NASA-CR-63045) CFSTI: HC $1.00/MF $0.50

The Dyadic Green's Function pertaining to the electromagnetic field in an infinite moving medium is derived. The derivation is based on Minkowski's theory, and the method of Fourier analysis is used. Also, a second derivation of the same result is given, which clearly shows the connection between the Green's functions for a moving and a stationary medium.
Author

N65-25192# AVCO-Everett Research Lab., Everett, Mass.
ON THE NATURE OF FLOWS THAT SATISFY A STOKES LINEARIZATION OF THE VORTICITY TRANSPORT EQUATION
Sheldon Weinbaum Apr. 1965 24 p refs
(Contracts DA-30-069-ORD-1955; DA-19-020-AMC-0210; ARPA Order 525; Proj. Defender)
(RR-211; AD-463395)

It is shown that a Stokes-type linearization of the vorticity transport equation is more general than previously supposed and can be used in some cases to describe flows with

large convective accelerations. These flows require not that their convective acceleration fields be vanishingly small (the usual "Stokes flow" assumption), but that they be nearly irrotational. This kinematic condition is approximately satisfied in many closed streamline flows, such as are frequently found in cavities and recirculation regions. Since these motions are approximately described by a Stokes-type differential equation, their streamline patterns are kinematically similar to Stokes flows though their dynamic behavior is different. Criteria which determine when the linearized equation is a good approximation are established. Methods of obtaining approximate solutions for flows with small irrotational acceleration fields, which can not be treated exactly, are discussed. Author

N65-25221# AVCO-Everett Research Lab., Everett, Mass.
STROUHAL NUMBERS FOR THE HYPERSONIC WAKES OF SPHERES AND CONES
A. Goldburg, W. K. Washburn, and B. H. Florsheim Apr. 1965 11 p refs
(Contracts DA-30-069-ORD-1955; DA-19-020-AMC-0210; ARPA Order 525; Proj. Defender)
(AMP-159; AD-462453)

Fay and Goldburg have presented evidence of the fluid mechanical similarity of the unsteady hypersonic wake and the unsteady incompressible wake. The Strouhal number (S=fL/V where V is the free-stream velocity, f is the wake periodic frequency and L is a characteristic length) is a characterization of the prominent large scale (wavelength) frequency in the unsteady wake. Recently, it was found that the Strouhal number variation for the incompressible wake for a range of cones and spheres could be correlated using a Reynolds number based on total wake momentum thickness as the characteristic length. A similar finding for the unsteady hypersonic wake is presented. Author

N65-25230# Cincinnati Univ., Ohio. Hypersonic Aerodynamics Research Staff
RECENT RESULTS IN THEORETICAL AND EXPERIMENTAL HYPERSONICS AND THEORETICAL MAGNETOHYDRODYNAMICS Final Summary Report, 1 Jul. 1961–30 Jun. 1964
Ting Yi Li et al Wright-Patterson AFB, Ohio, ARL, Jan. 1965 69 p refs
(Contract AF 33(616)-8453)
(ARL-65-18; AD-464207)

Theoretical and experimental results in continuum hypersonic flow and theoretical results in magnetohydrodynamics are reviewed and summarized. The theoretical investigation includes three-dimensional hypersonic flow problems, shock interaction studies, weak interacting hypersonic flow over cones, hypersonic leading edge problems, wake problems, and analysis of binary boundary layer problems. A method is reviewed whereby equations of a steady, two-dimensional compressible, isentropic flow of a perfectly conducting gas with an alined magnetic field can be reduced to those of the conventional nonmagnetic case. The experimental investigation was conducted in a Mach 14, 20-inch hypersonic wind tunnel. Topics investigated include the hypersonic wake problem, shock interaction, hypersonic flow over cones at low and high angles of attack, hypersonic inlet problems, hypersonic flow over flat plates with and without a glow discharge, and flow over delta wings at high angles of attack. Calibration of the tunnel is described and instrumentation used in conjunction with it is evaluated. Author

N65-25258# Hydronautics, Inc., Laurel, Md.
EXPERIMENTAL INVESTIGATION OF A SUPER-CAVITATING HYDROFOIL WITH UPPER SURFACE SPOILER FLAPS
J. O. Scherer and J. Auslaender Dec. 1964 159 p refs
(Contract NObs-88164)
(TR-343-2; AD-461883)

Results are presented of lift and drag measurements performed on a 2 1/2-in. chord model of parent supercavitating hydrofoil without flaps and with full span spoiler flaps. The tests were conducted in the high-speed, variable pressure, free surface, circulating water channel. They cover angles-of-attack ranging from 2.5° to 12.8°, vapor cavitation numbers from 0.075 to 1.38, and operating depths of 1/2 and 1 chord. The velocity during these tests was between 39 and 42 fps. Each of the three flap parameters—flap deflection, flap-chord ratio, and flap trailing edge location—were varied in three steps while the other two parameters were held relatively constant. The results are presented in graphs showing the variation of lift and drag with cavitation number and angle-of-attack. Graphs showing the reduction in lift due to the spoiler for each spoiler geometry and several cavitation numbers are also included. It is found that the upper surface spoiler flap is an effective way of reducing lift and that a discontinuity in lift at the ventilation inception angle can be avoided by proper selection of flap parameters. Author

N65-25284# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
STEADY EXPANSIONS AT HIGH SPEED RATIO USING THE B-G-K KINETIC MODEL
John W. Brook and Richard A. Oman Oct. 1964 35 p refs Presented at the 4th Intern. Symp. on Rarefied Gas Dyn., Toronto, Jul. 1964
(RE-183J)

Numerical calculations of axially symmetric and two-dimensional steady expansions of a monatomic gas were carried out, using an approximate Boltzmann equation with a Krook collision term. The calculations are performed for a variety of stagnation temperatures and sonic Reynolds numbers. At large distances from the sonic line, the velocity and density profiles follow the results predicted by inviscid flow theory, but the temperature "freezes" at a value dependent primarily on the sonic Reynolds number and stagnation temperature. A somewhat anomalous dependence of the final temperature on the particular initial distribution function used in the iterative procedure is also found. Transport data for argon have been used in the calculations. Author

N65-25295# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science
PROPAGATION OF SPACIALLY NON-UNIFORM SHOCK WAVES
Koichi Oshima Mar. 1965 10 p refs
(ISAS-397, Vol. 30, No. 6)

Effect of shear stress through a slipstream created behind a shock wave with nonuniform strength is discussed. An expression on the attenuation of the shock wave propagating through a channel with varying cross section and with momentum exchange between the neighboring stream tubes was obtained. Using this relation and the ray-shock theory, diffraction of shock waves around a sharp convex corner was analyzed. The result gives more reasonable shock patterns than those calculated by the ordinary analysis without shear effect. Author

N65-25312# Technische Hogeschool, Delft (Netherlands). Shipbuilding Lab.
THE DISTRIBUTION OF THE HYDRODYNAMIC FORCES ON A HEAVING AND PITCHING SHIPMODEL, WITH ZERO FORWARD SPEED IN STILL WATER

Ir J. Gerritsma and W. Beukelman Feb. 1965 26 p refs *Its* Publ. No. 124
(Contract N62558-4097)

Forced oscillation tests were carried out with a segmented ship model to investigate the distribution of the forces along the hull for heaving and pitching motions. The in-phase and quadrature components of the vertical forces on each of the seven sections were measured as a function of frequency, and an analysis was made of their distribution along the length of the ship model. The experimental results are compared with Grim's values for dumping and added mass. The comparison shows a satisfactory agreement between theory and experiment. Author

N65-25320# College of Aeronautics, Cranfield (England).
EXPERIMENTS ON INJECTION INTO AN INCOMPRESSIBLE TURBULENT BOUNDARY LAYER
T. N. Stevenson Oct. 1964 24 p refs
(CoA-Aero-177)

An experimental investigation into the characteristics of an axisymmetric incompressible turbulent boundary layer over a porous cylinder with air injection is described. The results agree with the theory of Black and Sarnecki, and the experimental results of Mickley and Davis, but disagree with the theory of Rubesin. The experimental results for the mean velocity distribution reveal two laws, one for the inner region, and one for the outer region which are valid for both suction and injection providing there is no pressure gradient. The laws reduce to the law of the wall and the velocity defect law when the transpiration velocity is zero. Author

N65-25360# Technical Univ. of Denmark, Lyngby.
MODEL-SCALE TESTS IN TURBULENT WIND. PART II: PHENOMENA DEPENDENT ON THE VELOCITY PRESSURE, WIND LOADS ON BUILDINGS
Martin Jensen and Niels Franck Copenhagen, Danish Techn. Press, 1965 178 p refs

A study designed to prove that the model law for phenomena in natural wind—which demands that in model tests consideration must be given to wind turbulence—is also valid for phenomena depending on wind velocity pressure is reported. Presented is a description of an experimental technique, based on the model law, which utilizes a pitot-static tube for measuring wind velocity and static pressure in nature; and preliminary results of wind load measurements on different models of houses and free roofs. S.C.W.

N65-25393# Wisconsin Univ., Madison. Mathematics Research Center
NUMERICAL STUDY OF THE NAVIER-STOKES EQUATIONS FOR THE PRODUCTION OF SMALL EDDIES FROM LARGE ONES
P. C. Jain Jul. 1964 39 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-491; AD-607807)

To investigate the process of grinding large eddies into smaller ones at high Reynolds numbers, a finite difference method is used to obtain the periodic solutions of the Navier–Stokes equations numerically when the initial motion is assumed to be

$$v_1 = \cos x \sin y \sin z,$$

$$v_2 = -\sin x \cos y \sin z, \text{ and}$$

$$v_3 = 0.$$

Mean square kinetic energy and mean square vorticity are calculated, and it is found that the numerical method provides estimates of these quantities up to $t = 1.90$ at $R = 200$ and up to $t = 1.70$ at $R = 1000$. Several other initial sets of vortices are used to find the behavior of λ, λ_n/λ and K at $t > 0$. Author

N65-25428 Joint Publications Research Service, Washington, D. C.
AIR (GAS) FLOW VIBRATIONS IN TUBE CLUSTERS OF BOILER ASSEMBLIES
V. V. Solov'yev 8 Jun. 1965 8 p refs Transl. into ENGLISH from Teploenerg. (Moscow), no. 7, Jul. 1960 p 32–34
(JPRS-30498; TT-65-31209) CFSTI: $1.00

The appearance of vibrations associated with the instability of air and gas flow around tube clusters at powerplants was investigated, the analytical results were compared with experimental data. It was found that the frequency of the breakaway of vortices from the tubes as well as the natural-oscillation frequency of the chambers induce the vibrations. The installation of baffles in the clusters running parallel with the flow changes the acoustic characteristics of the chambers and eliminates the vibrations completely. G.G.

N65-25444# General Applied Science Labs., Inc., Westbury, N. Y.
THE BLUNT BODY HYPERSONIC WAKE
Seymour L. Zeiberg and Gary D. Bleich 23 Jul. 1964 41 p refs
(Contract NOw-63-0637-c FBM)
(TR-451; AD-460901)

A method to calculate the hypersonic wake of blunt bodies is developed. The analysis employs a previously reported finite difference method for the viscous region, and one-dimensional inviscid streamline equations for the outer inviscid wake. Nonequilibrium air chemistry is included throughout. Calculations are compared to assorted ballistic range data, and agreement is seen to be reasonably good. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N65-24392# Geophysics Corp. of America, Bedford, Mass. GCA Technology Div.
MODEL ATMOSPHERES DETERMINED BY ABSORPTION OF SOLAR RADIATION Scientific Report No. 6
Raymond A. Minzner Oct. 1964 41 p refs
(Contracts NASw-976; AF 19(628)-1633)
(GCA-TR-64-13-A; AFCRL-64-874; AD-614085)

Atmospheric models consisting of altitude profiles of total scale height, number density of each of a number of constituents, and temperature may be computed from values of incident uv radiation, and a set of boundary conditions at a reference level near 150 km where the optical depth for the absorbed radiation is near unity and where the number density of each of the individual gas species is known. The method is an iterative one requiring machine calculation and based on rigorous equations relating total scale height versus altitude to the summation terms involving the absorption and reradiation profiles of the total atmosphere in narrow band increments. It was shown that if the absorption in some narrowband or line is the result of a single species and the absorption profile is known from h to the top of the atmosphere, the

scale height profile for that species and the kinetic temperature profile are also known from h to the top of the atmosphere. Author

N65-24393# Dartmouth Coll., Hanover, N. H. Radiophysics Lab.
STUDIES OF SPATIAL IRREGULARITIES IN THE IONOSPHERE AND THEIR VARIATIONS WITH TIME Final Report, Oct. 1, 1961–Apr. 30, 1964
M. G. Morgan 12 Oct. 1964 23 p refs
(Contract AF 19(628)-353)
(AFCRL-64-959; AD-610721)

Results of a search for propagation of high frequency waves in magnetospheric ducts from the Northern to the Southern Hemisphere were negative. Development of techniques and equipment for study of traveling ionospheric disturbances by oblique-path ionograms continued. System synchronization is obtained by basing the frequency sweeps and pulsing on stable frequency standards at each location. Frequency sweeping is phased to transmissions from WWV, CHU, or NBA, and pulsing is phased to transmissions from Loran-C stations. Traveling ionospheric disturbances are discussed. Effect of gravity on magnetoacoustic waves in the ionosphere was studied theoretically. Moving irregularities observed on an ionosonde at vertical incidence were reduced to true height and analyzed in terms of the theoretical findings. Author

N65-24399# Norwegian Defence Research Establishment, Kjeller.
A STUDY OF IONOSPHERIC IRREGULARITIES Final Report
P. Christophersen 23 Oct. 1964 127 p refs
(Contract AF 61(052)-500; Grant AF-EOAR-62-33)
(E-43; AFCRL-65-56; AD-610861)

Irregular structure and irregular motions in the F-layer of the ionosphere are investigated through the study of the correlation between radio waves reflected at closely spaced frequencies. Results from observations made at 4 MHz in the daytime and the evening are presented. The frequency range over which correlation remains is highly variable and lies between 10 and 100 kHz. Author

N65-24443# Lowell Technological Inst. Research Foundation, Mass.
AN ELECTROOPTICAL SYSTEM FOR THE STUDY OF CLOUD-TO-GROUND LIGHTNING Final Report, 1 Jun. 1963–30 Sep. 1964
Richard E. Kenyon Dec. 1964 94 p
(Contract AF 19(628)-2972)
(AFCRL-64-1002; AD-613544)

Efforts included design, fabrication, test and operation of a system of electro-optical instrumentation for recording by electronic and photographic means, parameters of cloud-to-ground lightning strokes. Instrumentation, test results and field operations are described. Author

N65-24451# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
CONFINED CREEP TESTS ON POLAR SNOW
Malcolm Mellor and George Hendrikson Feb. 1965 13 p refs
(CRRL-RR-138; AD-613043)

Snow was sampled from various depths below the surface of the ice sheet at Byrd and Amundsen-Scott Stations, Antarctica. The samples were obtained either by sawing blocks from trench and tunnel walls or by coring with a hand auger. The mechanics of creep are discussed, and the data are tabulated and graphed with respect to temperature and density effects. At the lower densities, the compressive viscosities are in reasonable agreement with those deduced from depth-density profiles. At the higher densities, the viscosities are significantly lower than those calculated from depth-density profiles. It is suggested that part of the discrepancy may be attributed to the strain history of the snow. The creep tests suggest a functional relationship between viscosity and density different from that suggested by analyses of natural snow densification. Author

N65-24461# Smithsonian Astrophysical Observatory, Cambridge, Mass.
THE VOLCANIC DUST SAMPLING PROGRAM OF THE SMITHSONIAN ASTROPHYSICAL OBSERVING STATIONS
Frances W. Wright and Paul W. Hodge 28 Apr. 1965 16 p refs
(SAO Special Rept.-172)

A worldwide investigation of volcanic dust was instigated because of the problem of distinguishing between volcanic and meteoritic particles found in terrestrial sediments. Volcanic dust samples at active and recently active volcanoes in Hawaii, Central America, and South America were obtained. Physical and chemical analyses of these samples provided criteria for identification. Author

N65-24522*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A RADIATION CLIMATOLOGY IN THE VISIBLE AND INFRARED FROM THE TIROS METEOROLOGICAL SATELLITES
W. R. Bandeen, M. Halev, and I. Strange Washington, NASA, Jun. 1965 34 p refs
(NASA-TN-D-2534) CFSTI: HC $2.00/MF $0.50

Radiometric measurements in the visible and infrared were made intermittently since 1960 by the meteorological satellites Tiros II, III, IV, and VII. Measurements of reflected solar radiation were acquired within filtered passbands of approximately 0.2μ to 6μ and 0.55μ to 0.75μ and, of emitted long wave radiation, within passbands of approximately 8μ to 12μ, 8μ to 30μ, 6μ to 6.5μ, and 14.8μ to 15.5μ. Tiros VII has acquired continuous radiometric data over the earth for more than a year, increasing significantly the potential of its data for climatological studies, as compared to the earlier experiments of shorter duration. A limited climatology of the spatial and temporal variations of the total outgoing long wave radiation and of the planetary albedo is derived from the beam measurements within the 5° field of view of the Tiros VII five-channel scanning radiometer. The results agree with previous studies of the planetary heat balance, based on conventional data, but several differences appear. The satellite data indicate a disproportionately high emission of radiation from the subtropical anticyclones, while the meridional gradient of the mean zonal albedo is larger than indicated in several recent studies. In addition, the relative planetary distribution of atmospheric moisture is inferred from measurements within the 6.3μ band of water vapor, and the seasonal changes of mean temperatures in the stratosphere between about 15 and 35 km are shown from measurements within the 15μ band of CO_2. Author

N65-24533 Joint Publications Research Service, Washington, D. C.
APPLICATION OF THE METHODS OF STATISTICAL RADIOPHYSICS TO THE STUDY OF THE MOVEMENT OF THE EARTH'S POLES
V. Ya. Yashkov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 95–102 refs (See N65-24525 14-07) CFSTI: $7.00

A spectral analysis is made of the earth pole coordinates which were calculated according to the Orlov method for a period of 70.5 years. It is shown that the free nutation of the

pole consists of two movements with the periods of 1.17 and 1.20 yr, respectively; both are elliptical. Author

N65-24594# Navy Electronics Lab., San Diego, Calif.
MODEL STUDIES OF THE NIGHTTIME IONOSPHERIC D REGION FROM POLARIZATION MEASUREMENTS MADE AT THE GROUND Research and Development Report, Jan.–Jul. 1964
E. E. Gossard 6 Nov. 1964 66 p refs
(NEL-1249; AD-456418)

Through very low radiofrequencies, polarization characteristics of ionospherically reflected electromagnetic waves were measured to determine electron density and collision frequency distribution in the lower ionosphere. It is concluded that the nighttime fluctuation in the phase and amplitude observed on short, very-low-frequency radio paths is typically due to interference between two or more reflected waves. Several hypothetical models have been investigated to determine their effect on the polarization of the downcoming sky wave. A fairly simple two-layer model seems capable of explaining the observed variability in the polarization data; other models containing only one layer in the D and E regions appear unable to account for the observations. Author

N65-24628# Joint Publications Research Service, Washington, D. C.
MACHINE PROCESSING OF OCEANOGRAPHIC CHARACTERISTICS
V. A. Burkov and Ya. L. Tsipis 12 May 1965 85 p refs Transl. into ENGLISH from Tr. Inst. Okeanol. (Moscow), v. 75, 1964 p 3–61
(JPRS-30031; TT-65-30971) CFSTI: $3.00

Machine processing of oceanographic characteristics is discussed, using the example of deep-water hydrologic observations, i.e., the temperature, salinity, density, specific volume and oxygen content. Many problems solved for these characteristics will remain in force with respect to other characteristics also for example, the ocean current components, wave elements, etc. Author

N65-24648# Joint Publications Research Service, Washington, D. C.
STUDIES IN GLACIER RECESSION, EARTH ATMOSPHERE CIRCULATION, AND INDIAN OCEAN MAPPING
24 May 1965 48 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Geogr. (Moscow), no. 2, Mar.–Apr. 1965
(JPRS-30216; TT-65-31065) CFSTI: $2.00

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1. THE POSSIBLE INFLUENCE OF ATMOSPHERIC DUSTINESS ON THE RECESSION OF GLACIERS AND WARMING OF THE CLIMATE F. F. Davitaya p 1–25 refs
2. SCIENTIFIC CONFERENCE ON THE PROBLEM "GENERAL CIRCULATION OF THE EARTH'S ATMOSPHERE" A. S. Chaplygina p 26–34
3. NEW MAP OF THE RELIEF OF THE SEA BOTTOM IN THE SOUTHERN PART OF INDIAN OCEAN A. V. Zhivago, O. N. Vinogradov, G. M. Braslavskaya, and N. A. Timofeyeva p 35–45 refs

N65-24650 Polish Academy of Sciences, Warsaw. Comm. on International Cooperation in Geophysics
BULLETIN OF POLISH OBSERVATIONS OF THE ARTIFICIAL SATELLITES [BIULETYN POLSKICH OBSERWACJI SZTUCZNYCH SATELITOW]
Ludoslaw Cichowicz et al Sep. 1964 61 p refs In POLISH; ENGLISH summary *Its* Bull. No. 11

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1. THE PROBLEMS OF ASTROMETRY, GEODESY AND SATELLITE GEOPHYSICS AT THE 5TH COSPAR SYMPOSIUM, FLORENCE, MAY 8–20, 1964 Ludosław Cichowicz p 1–9
2. ALPHABETIC LIST OF POLISH REPORTS ON SPACE RESEARCH Ludosław Cichowicz and W. Zonn p 10–28
3. RADIO SIGNALS OF THE ARTIFICIAL EARTH SATELLITES AS A SOURCE OF INFORMATION ON THE STRUCTURE OF THE UPPER IONOSPHERE Andrzej W. Wernik p 29–39 refs
4. DETERMINATION OF POSITION OF THE OPTICAL CENTER OF PLATE BY MEANS OF STELLAR OBSERVATIONS IN THE LOCAL MERIDIAN Jan Bieniewski p 40–44 refs
5. SATELLITE 1960 EPSILON 2—EVALUATION OF THE ACCURACY OF OBSERVATIONS CARRIED OUT WITH THE TELESCOPE AT-1 Michał Hajduczenia p 45–53 refs
6. LIST OF SATELLITE OBSERVATIONS PERFORMED BY THE POLISH OBSERVATION STATIONS p 54–59

N65-24657*# National Aeronautics and Space Administration, Washington, D. C.
GRAVITATIONAL SEPARATION, COMPOSITION AND STRUCTURAL PARAMETERS OF THE NIGHT ATMOSPHERE IN THE 100-210 KM ALTITUDE RANGE [GRAVITATSIONNOYE RAZDELENIYE, SOSTAV I STRUKTURNYYE PARAMETRY NOCHNOY ATMOSFERY NA VYSOTAKH OT 100 DO 210 KM]
A. A. Pokhunkou Oct. 1962 17 p refs Transl. into ENGLISH from Iskusstv. Sputniki Zemli (Moscow), no. 13, 1962 p 110–118
(NASA-TT-F-8284) CFSTI: HC $1.00/MF $0.50

Measurements of the composition of the upper atmosphere (nonionized gases) were made by a five-cascade radiofrequency mass spectrometer in a retrievable geophysical container separating from the rocket. Raising of the container was accomplished with the aid of a large geophysical rocket vertically to the altitude of 210 km. Measurements of the composition were made after container's separation, at distances from the rocket in the range of several tens to several hundred meters. An improved variant of radiofrequency mass spectrometer was used in comparison with that used in previous experiments. Fifty-one and fifty mass spectra of atmospheric gases were obtained at ascent and descent, respectively, in the 100- to 210-km range. Author

N65-24666*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF THE LOWER IONOSPHERE BY MEANS OF LONG RADIOWAVES AND ROCKET-BORNE LOW-FREQUENCY RADIOSONDES. DETECTION OF A NEW IONOSPHERE LAYER [ISSLEDOVANIYE NIZHNEY IONOSFERY S POMOSHCH'YU DLINNYKH RADIOVOLN I NIZKOCHSTOTNYMI RADIOZONDAMI, USTANOVLENNYMI NA RAKETE. OBNARUZHENIYE NOVOGO SLOYA IONOSFERY]
P. E. Krasnushkin and N. L. Kolesnikov Nov. 1962 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 146, no. 3, 21 Sep. 1962 p 596–599
(NASA-TT-F-8313) CFSTI: HC $1.00/MF $0.50

Two methods are presented for the investigation of the ionosphere in the 50- to 90-km altitude range: (1) coordination of all data on long and superlong radiowaves and on the propagation medium with the aid of theoretical functional links from the solution of the Maxwell equation boundary problem; and (2) impedance measurements of a miniature T-type collapsible-whip antenna, placed on the lateral surface of a vertically

flying rocket. The latter device measured the effective conductance and the true dielectric constant in the earth's magnetic field nearly normal to the antenna field. Preliminary results of measurements from launchings in August 1958 and July 1959 are plotted, together with the averaged results obtained by the first method during the period of solar activity maximum. It was concluded that neither of the observable solar radiations penetrates the 57- to 67-km altitude region, and that the fluctuations in the altitude ranges 57 to 67 km during the summer and in the 57- to 80-km range during the winter are induced by radiation of nonsolar origin. G.G.

N65-24667*# National Aeronautics and Space Administration, Washington, D. C.
DETERMINATION OF ELECTRON DENSITY IN THE IONOSPHERE BY ANALYSIS OF POLARIZATION FADINGS OF SATELLITE OR ROCKET SIGNALS [OPREDELENIYE KONTSENTRATSII ELEKTRONOV V IONOSFERE NA OSNOVE ANALIZA POLYARIZATSIONNYKH ZAMIRANIY SIGNALOV ISKUSSTVENNOGO SPUTNIKA ZEMLI ILI RAKETY]
S. A. Namazov Oct. 1962 12 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), no. 8, p 1311–1315
(NASA-TT-F-8308) CFSTI: HC $1.00/MF $0.50

Examined is the phenomenon of radiowave polarization plane rotation in case of waves emitted by a transmitter of a rocket or an artificial satellite. The discussion centers on the possible method of obtaining the distributions of electron concentration in the observed altitude range by the recordings of polarization fadings of signals emitted by rocket or satellite transmitter. A possible principle is proposed for the construction of a device measuring the frequencies of polarization fadings. Author

N65-24669*# National Aeronautics and Space Administration, Washington, D. C.
VARIATION IN THE NIGHT ATMOSPHERE OF THE MEAN MOLECULAR WEIGHT OF THE AIR IN THE 100 TO 210 KM ALTITUDE RANGE ACCORDING TO MASS-SPECTROMETRIC MEASUREMENTS [OB IZMENENII SREDNEGO MILEKULYARNOGO VESA VOZDUKHA V NOCHNOY ATMOSFERE NA VYSOTAKH OT 100 DO 210 KM PO MASS-SPEKTROMETRICHESKIM IZMERENIYAM]
A. A. Pokhunkov Sep. 1962 14 p refs Transl. into ENGLISH from Iskusstv. Sputniki Zemli (Moscow), v. 12, 1962 p 133–140
(NASA-TT-F-8282) CFSTI: HC $1.00/MF $0.50

Described is a five-cascade radiofrequency mass spectrometer that, by maximum contraction of the inlet nozzle length and an increase of its diameter, reduces the relative concentration of atomic oxygen to the minimum by recombination when it enters the ion source. This analyzer obtained 50 mass spectra at ascent, and 51 at descent over a 100- to 210-km altitude range during a night flight in September 1960. The observed relative O_1 and N_2 concentrations were compared with data from another device that allowed the entering oxygen atoms to collide substantially before reaching the ionizing region of the ion source, and it was shown that the atomic oxygen concentration at all altitudes was about four times greater in measurements with the first analyzer than in those made by the other device. The main components in the indicated altitude range were molecular nitrogen, and atomic and molecular oxygen. The relative concentration of atomic oxygen increased about five times with height and constituted nearly 65% ±20% of the molecular nitrogen concentration. Computations of the obtained data found a still significant quantity of molecular oxygen at 210 km. G.G.

N65-24672*# National Aeronautics and Space Administration, Washington, D. C.
DIRECT MEASUREMENTS OF AIRGLOW IN THE REGION λ = 8640 Å [PRYAMYYE IZMERENIYA SVETIMOSTI NOCHNOGO NEBA V SPEKTRAL'NOY OBLASTI λ = 8640 Å
T. M. Tarasova Sep. 1962 5 p Transl. into ENGLISH from Iskusstv. Sputniki Zemli (Moscow), no. 13, 1962 p 107–109
(NASA-TT-F-8285) CFSTI: HC $1.00/MF $0.50

Presented are results of preliminary processing of experimental data. The purpose was to investigate distribution in height of the night sky glow in the region of the spectrum λ = 8640 Å, in which emission of molecular oxygen is concentrated. The investigated region was outlined with an interference light filter with a half-width λ = 280 Å. The photometer was raised to 200 km by a rocket; it effected complex motions during measurements described as follows: The photometer's axis was directed toward the zenith over the portion of altitudes from 65 to 75 km; as of 75 km the device begins a rotation attended by increase of the intensity registered by it. In the 110- to 160-km range the axis of the device is directed downward, and at 170 to 200 km—again toward the zenith. In the descending branch of the trajectory the axis was always directed toward earth from h = 200 km to h = 140 km. Author

N65-24695# Joint Publications Research Service, Washington, D. C.
MEASURING INFORMATION SYSTEMS FOR GEOPHYSICAL RESEARCH
K. V. Karandeyev and G. A. Stamberger 2 Jun. 1965 7 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 2, Feb. 1965 p 58–61
(JPRS-30375; TT-65-31139) CFSTI: $1.00

Two aeroelectrosurveying methods are described. The first uses an outside measuring device with the primary field created by a long wire fed by an ac cable. This measures the horizontal component of the field intensity vector in a coordinated system when flying perpendicular to the cable. The second method utilizes two aircraft in rigorous axial alinement and the rotating magnetic field between them to determine any conductive object that disturbs the equilibrium. The measuring apparatus of the aero method device based on the use of natural electromagnetic fields is illustrated. G.G.

N65-24706# Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology
A REVIEW OF STUDIES OF EDDY FLUXES IN THE STRATOSPHERE AND MESOSPHERE
Reginald E. Newell 14 Jan. 1965 72 p refs Presented to the Colloq. on Meteorol. Problems in the Stratosphere and Mesosphere, Paris, 8–12 Mar. 1965
(Contract AT(30-1)-2241)
(Rept.-12)

An investigation of eddy transport or flux and its role in large scale atmospheric circulation in the stratosphere and mesosphere is presented. Eddy transport can be resolved into three components: mean meridional motions, standing eddies, and transient eddies. Eddy flux measurements in the lower stratosphere indicate that the middle latitude portion is a refrigerated region which receives its driving energy from below. Changes in this driving energy can be responsible for sudden warmings and the annual and 26-month oscillation in tropical temperatures and winds above 100 millibars. It is yet to be determined how this momentum and energy are transferred to the stratosphere. The only reliable eddy transport measurements in the upper stratosphere and mesosphere are those of transient eddy flux. This flux plays an important role in the momentum budget in the

winter season. The role of standing eddies and mean meridional motions cannot be determined until a global network of meteorological stations is available. R.N.A.

N65-24731# Buenos Aires Univ. (Argentina). Instituto de Calculo
THE HIGH ATMOSPHERE AND ARTIFICIAL SATELLITES [LA ALTA ATMOSFERA Y LOS SATELITES ARTIFICIALES]
Pedro E. Zadunaisky Buenos Aires, Comision Nacl. de Invest. Espaciales, 1964 68 p refs In SPANISH; ENGLISH summary (CNIE-Pt-2)

The analytic process of the determination of atmospheric density is detailed through the study of the deceleration and contraction of the orbit of artificial satellites produced by air drag, and of the various factors which effect the results. A description is given of different discoveries made through the use of this technique, as well as of the most recent conclusions reached on the high atmosphere's behavior, in particular, the sun's energy fluctuations on which it is closely dependent. Author

N65-24747 Joint Publications Research Service, Washington, D. C.
SEASONAL VARIATION OF INFRARED RADIATION OF THE EARTH AND ATMOSPHERE
M. N. Markov, Ya. I. Merson, and M. R. Shamilev *In its* Cosmic Radiation Studies 27 May 1965 p 46-68 refs (See N65-24744 14-29) CFSTI: $3.00

The paper describes results of an investigation of the field of thermal radiation of the earth and atmosphere by measurement of the angular distribution by an apparatus lifted on geophysical balloons to about 29 km. Experimental data are cited on the absolute quantity of that radiation and data on seasonal variations of the shape of the curve of the angular distribution of that radiation. Noncoincidence of the experimental data with theoretical calculations is pointed out. Investigations of the infrared radiation of the earth by an apparatus lifted on geophysical balloons, made in 1960 through 1961, have shown that this method permits obtaining valuable material for constructing a general picture of the radiation of the earth into space. Author

N65-24762# Weapons Research Establishment (Australia).
THE TRACING OF RADIO WAVES IN THE IONOSPHERE
M. G. Golley Feb. 1965 38 p refs
(WRE-TN-PAD-96)

A method for tracing radiowaves in the ionosphere, in the presence of the earth's magnetic field is described. The method consists of solving a set of differential equations, whose solutions give the position of the ray as a function of the ray path length. An IBM 7090 program was written to give the general solution to the problem; results of several ray tracings are presented. Author

N65-24786# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy
GEOGRAPHIC CHARTS AND ALTITUDE PLOTS FOR SELECTED VALUES OF GEOMAGNETIC SHELL PARAMETERS B AND L
Bharathi Venkatesan Mar. 1965 58 p refs
(Contracts Nonr-93803; Nonr-1509(06))
(Rept. 65-8; AD-614101)

Using the Jenson and Cain (1963) coefficients for the geomagnetic field for the Epoch 1960, and McIlwain's B-L program, a grid of values of B and L was computed for the altitudes 0, 100, and 1000 KM, for the latitude belt 70° N to 70° S in steps of 2° for the latitudes and 5° for the longitudes. Interpolations give the isocontours for selected values of L and B at these three heights. These are shown in maps. A map which gives the plot of isocontours of L on the surface of the earth as seen from the North and South Poles is presented. An extension of the B-L grid to the remaining altitudes up to 2000 km in steps of 100 km is carried out. However, a latitude interval of 5° and a longitude interval of 10° are adopted. The computations are also extended beyond 70° latitude for some chosen longitudes necessitated by the following study. For the study of the drift of trapped particles around the earth, a useful work would be to plot isocontours of constant B and L. The altitudes for any particular combination of B and L are plotted as a function of longitude. Maps showing such plots for the Southern and Northern Hemispheres are presented. TAB

N65-24807# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
GEOPHYSICS AND SPACE DATA BULLETIN, NO. 2
Anne L. Carrigan and Norman J. Oliver, ed. Oct. 1964 196 p refs
(AD-609997)

Presented are component magnetometer data, cosmic-ray neutron intensity monitor network data, and oblique backscatter radar data for April, May, and June 1964. Results from oblique H-F propagation measurements from a Puerto Rico to Uruguay path are presented, together with a program description. Also shown are riometer data from stations in Peru, Phillippines, Hawaii, Brazil, and Greenland for April, May, and June 1964, and for the USA for May and June 1964. Solar radio emission-spectral observation data from a Texas station are presented for April, May, and June 1964. G.G.

N65-24832# Naval Weapons Lab., Dahlgren, Va. Computation and Analysis Lab.
COMPUTATIONAL METHODS EMPLOYED IN DERIVING GEODETIC RESULTS FROM DOPPLER OBSERVATIONS OF ARTIFICIAL EARTH SATELLITES
Richard J. Anderle May 1965 33 p refs Presented at the Joint Symp. on Trajectories of Artificial Celestial Bodies as Determined from Observations, Paris, Apr. 1965
(NWL-1977; AD-462610)

The computational model used to obtain geodetic data from Doppler observations on satellites is discussed. Some selected problems studied and discussed include (1) the effects of bias on the accuracy of the solution and on the validity of statistical tests of the accuracy of the solution, (2) the results obtained and the methods of accounting for the effects of tesseral gravitational harmonics such as $C_{13,13}$-$S_{13,13}$ which produce resonant effects on the satellite motion, and (3) the method of determining and representing the significant gravity coefficients. The accuracy of orbit computation currently being achieved as a result of recent improvements in the gravity field representation is shown to be about 50 meters. Author

N65-24912 National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board
THE IONOSPHERE
In its U.S. Space Sci. Program, Rept. to COSPAR 1963 p 36-49 ref (See N65-24908 14-30)

Study is made of the D, E, and F layers, to some extent with low-energy phenomena in the magnetosphere, and with those ground-based studies carried out in coordination with space researches. Since the origin of phenomena of the other planets connected with ionization and radiofrequency radiation is not yet sufficiently clear to identify them with a definite entity such as an ionosphere, research on this subject has been reported. Some investigations of terrestrial phenomena in which the interaction of the circumterrestrial medium with

outside influences plays a predominant role have been reported. Author

N65-25009*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station
ATMOSPHERIC OSCILLATIONS
A. J. Lineberger and H. D. Edwards Apr. 1965 33 p refs
(Grant NsG-304-63; Contract AF 19(628)-393)
(NASA-CR-62898) CFSTI: HC $2.00/MF $0.50

The development of present theories of atmospheric oscillations is outlined with special emphasis given to upper atmospheric motions. The general mathematical attack is summarized, and references to complete derivations are included. Current research on atmospheric oscillations was related to studies of atmospheric phenomena. The relation of postulated gravity waves to observed wind motion was considered with reference to a downward propagation of gravity wave phase velocity, a phase change in the region of a negative temperature gradient, and the energy flux from the lower atmosphere to the upper atmosphere. Author

N65-25012*# Geophysics Corp. of America, Bedford, Mass. Technology Div.
ERROR ANALYSIS ON INVERSION TECHNIQUES Interim Scientific Report No. 1, 23 May 1963–30 Nov. 1964
Jean I. F. King Nov. 1964 46 p refs
(Contract NAS5-3352)
(NASA-CR-62933; GCA-TR-64-16-N) CFSTI: HC $2.00/MF $0.50

Progress toward finding an optimum inversion technique for inferring vertical thermal structure from satellite infrared observations is documented. The major part of the research, which has appeared in scientific literature, and the unpublished material, which tests the new inversion method under random observational errors, are included. Author

N65-25178# United Kingdom Atomic Energy Authority, Harwell (England). Atomic Energy Establishment
RADIOACTIVE FALL-OUT IN AIR AND RAIN: RESULTS TO THE MIDDLE OF 1964
R. S. Cambray, E. M. R. Fisher, G. S. Spicer, C. G. Wallace, and T. J. Webber 1964 42 p refs
(AERE-R-4687) HMSO: 6s

Samples of atmospheric dust and rainwater were collected from the United Kingdom and overseas. Results are presented of the analyses of these samples for various fission products, and for the activation product manganese 54. The concentrations of the long-lived fission products Cs^{137} and Sr^{90} in air and rain over the United Kingdom are, in 1964, about 75% of those in 1963. It is believed that the long-lived fallout debris in 1964 originated from a source in the upper atmosphere and that the tropospheric concentrations in future years may approximate the 1964 level with but a small (c. 10%) annual diminution. Integration over the world of the deposition of Sr^{90} in rain provides an estimate of the total global deposition to the end of 1963. The ratio of Cs^{137} to Sr^{90} in rain over the United Kingdom decreased from a mean value of 1.69 for the two years 1960/61 to 1.57 for the period 1962/63 possibly due to fractionation effects. Author

N65-25412# Air Force Cambridge Research Labs., Bedford, Mass. Aerospace Instrumentation Lab.
CORRELATIONS OF TEMPERATURE, PRESSURE, AND DENSITY, TO 30 KILOMETERS AF Surveys in Geophysics No. 160
A. E. Cole and P. F. Nee Jan. 1965 82 p refs
(AFCRL-65-43; AD-612651)

Arrays of means and standard deviations of temperature and density for 2-km intervals of altitude up to 30 km, together with inter- and intralevel coefficients of correlation of density with density, temperature with temperature, and temperature with density, are presented for midseason months at four locations. Temperature and density at the same level are, in general, negatively correlated at altitudes below 30 km. A level of minimum seasonal and latitudinal temperature variability occurs between 12 and 14 km. Seasonal temperature variability is largest near the earth's surface, and the latitudinal variability is greatest between 14 and 17 km. Density variability is least near 8 km, the isopycnic level. A level of maximum seasonal and latitudinal density variability occurs between 12 and 14 km. Means and standard deviations of surface pressure and coefficients of correlation between surface pressure and temperatures at levels up to 30 km are presented and discussed. Examination of the relationship between standard deviation of surface pressure and coefficients of variation of density at the level of maximum variability indicates variation of surface pressure is not a good index of variations in the vertical density distribution. Author

N65-25414# Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.
MASS SPECTROMETRY IN THE D-REGION IONOSPHERE—APPARATUS, TECHNIQUES, AND FIRST MEASUREMENTS Environmental Research Papers No. 82
R. S. Narcisi and A. D. Bailey Feb. 1965 53 p refs
(AFCRL-65-81; AD-613042)

A quadrupole mass spectrometer system employing a liquid nitrogen chilled zeolite pump developed for sampling positive ions at altitudes above 50 kilometers provided the first positive ion composition measurements in the D-region. Due to the high sensitivity of the system, approximately 20 positive ion peaks were detected in the mass range 10 to 45 amu within the altitude range 64 to 112 km. Predominant ions detected within the D-region (64 to 82 km) were 18^+, 30^+, and $(37 \pm 1)^+$. At 82.5 km a sharp transition occurred in the spectra, characterized by the rapid disappearance of 18^+ and 37^+ and instantaneous appearance of six new ion peaks. Five of these ion peaks are suggested to be the metallic ions of sodium (23^+), magnesium (24^+, 25^+, 26^+) and calcium (40^+). Metallic ions exhibited an identical altitude profile, a 10-km wide peak with maximum at 95 km, minimum at 105 km, then continuously increasing until apogee at 112 km. This profile compares favorably with measurements of twilight emissions, rocket ion probes data, and radio echos of meteor trails. It is estimated that the magnesium ions comprise roughly 10% of the total ion density at 95 km. Above 82 km the ions 30^+ and 32^+ appear most predominant. A sensitivity curve, derived by using the ion densities obtained from the electrostatic probes, is used to convert the ion peak currents into ambient ion densities. Aerodynamic and plasma phenomena associated with D-region sampling are discussed. Author

N65-25424# California Univ., Berkeley. Dept. of Physics
BALLOON MEASUREMENTS OF X-RAYS IN THE AURORAL ZONE. III: HIGH TIME RESOLUTION STUDIES
K. A. Anderson and D. W. Milton 1 May 1964 61 p refs
(Contracts Nonr-222(40); Nonr-3656(13))
(UCB-64/5; AD-461014)

The main objective of the experiment is to examine temporal features in the auroral zone X-ray fluxes above 30 keV photon energy with resolution to intervals as short as a few milliseconds. It is desired to apply high resolution analysis to small and moderate auroral X-ray fluxes which occur with much greater frequency than do extremely high fluxes. The X-ray detector is a thallium-activated sodium iodide scintillation crystal 5 inches in diameter and 1/2-inch thick. The overall energy resolution due to detector effects varied from 25 to 35 percent FWHM. Author

N65-25453# Library of Congress, Washington, D. C. Aerospace Technology Div.
IRREGULAR MICROPULSATIONS OF THE EARTH'S ELECTROMAGNETIC FIELD IN THE AURORAL ZONE AND THEIR CORRELATION WITH AURORAS AND THE IONOSPHERIC E_s LAYER [IRREGULYARNYYE MICROPULSATSII ELEKTROMAGNITNOGO POLYA ZEMLI V ZONE SIYANIY I IKH SVYAZ S POLYARNYMI SIYANIYAMI I SLOYEM E_s IONOSFERY]
R. G. Skrynnikov and N. F. Mal'tseva 17 May 1965 11 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 5, no. 1, 1965 p 121–125
(ATD-T-65-26) CFSTI: HC $1.00/MF $0.50

A correlation is established between the amplitudes of micropulsations of an electromagnetic field and the variations of luminous flux for individual periods of variations. It is asserted that the simultaneous change in both the ionizing and the exciting capacity of the solar corpuscular stream is the cause of variations, while the amplitude and the number of magnetic micropulsations are regulated by the dynamic action of the ionospheric wind. It is shown that the appearance of Sip-type micropulsations is associated with the appearance of sporadic formations in the ionospheric E-layer and is controlled by those zones of the ionosphere in which the lower limit of the auroras is situated. Author

N65-25456# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
THE DENSITY-FLOW REGIME OF FRANKLIN D. ROOSEVELT LAKE
R. T. Jaske 15 Mar. 1965 32 p refs
(Contract AT(45-1)-1350; AT(45-1)-1830)
(BNWL-20)

Correlation of 2-yr data describing the thermal regime of Lake Roosevelt and comparisons with Yih's theoretical work and Debler's laboratory studies shows excellent agreement regarding the position of the interfacial layer between the upper relatively stagnant zone and the region of the primary flow transport. Further study of the temperature data and confirmation by velometer shows location of a second, lower interface that roughly conforms to the one above but showing waves of instability. The study indicates that projects or operational concepts involving storage or release of cool water are difficult because density currents tend to bypass cooler masses. Dynamic equilibrium prevents formation of normal density currents and, as a result, Lake Roosevelt fills with cool water by displacement from the North without any significant horizontal distribution. Author

N65-25463# Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev.
BARRIER ATTENUATION OF AIR-SCATTERED GAMMA RADIATION
Z. G. Burson and R. L. Summers Oak Ridge, Tenn., AEC, 18 Jun. 1965 94 p refs
(CEX-63.3) CFSTI: $1.00

Experiments were performed to measure the attenuation provided by vertical and horizontal barriers of various materials subjected to skyshine radiation originating from simulated plane sources of cobalt 60 and cesium 137. Specific measurements were made to determine (1) quantitatively the skyshine dose rate in an open hole as a function of distance from a cobalt 60 source on the ground; (2) lip scatter and wall backscatter corrections for a detector in an open hole exposed to skyshine radiation from a simulated plane source of cobalt 60; (3) qualitatively the geometric factor describing a detector response to scattered gamma rays at the air–ground interface from a point isotropic cobalt 60 source on the ground 100 ft away; (4) the attenuation of skyshine radiation from simulated plane sources of cobalt 60 and cesium 137 by vertical barriers of concrete, steel, aluminum, and wood; and (5) the attenuation of skyshine radiation from cobalt 60 sources by horizontal barriers of concrete, steel, aluminum, and wood. The results provide shielding information for basement roofs and exposed basement walls from skyshine radiation originating from fallout. N.E.A.

N65-25510# Joint Publications Research Service, Washington, D. C.
MEASUREMENT OF RADIO-WAVE ABSORPTION AT LOPARSKAYA
N. A. Svetasheva 7 Jun. 1965 9 p refs Transl. into ENGLISH from the publ. "Issled. Geofizicheskikh Yavleniy Elektromagnitnogo Kompleksa v Vysokikh Shirotakh," Moscow, 1964 p 54–59
(JPRS-30446; TT-65-31179) CFSTI: $1.00

Polar measurements of radio wave absorption in the ionosphere based on the comparison of reflected pulse amplitudes were analyzed and showed good agreement between the seasonal changes of absorption and the magnetic activity, indicating the corpuscular nature of high latitude absorption. Radio wave absorption in summer and at the equinox had a maximum near midday caused by solar wave radiation. Winter radio wave absorption was characterized by a maximum in the night hours and a minimum in the near midday hours, which coincided with the diurnal variation. G.G.

N65-25516# Joint Publications Research Service, Washington, D. C.
MODERN TECHNIQUES IN ATMOSPHERIC RESEARCH
A. F. Maklakov and V. S. Khakhalin 11 Jun. 1965 131 p refs Transl. into ENGLISH of the book "Sovremennaya Tekhnika Issledovaniya Atmosfery" Leningrad, Hydrometeorology Publishing House, 1964 p 2–131
(JPRS-30574; TT-65-31248) CFSTI: $4.00

Modern technical means of atmospheric research—radiosondes, meteorological and geophysical rockets, artificial earth satellites, and other apparatus are presented. Brief descriptions of the methods and instruments used are also given. Author

N65-25521# Kitt Peak National Observatory, Tucson, Ariz.
MODELS FOR THE TERRESTRIAL ATMOSPHERE ABOVE THE 120 km LEVEL
Michael B. Mc Elroy Mar. 1964 46 p refs *Its* Contrib. No. 55

The analytic expressions for the temperature and density of an analytic model thermosphere are presented, and a range of model atmospheres is tabulated. The models given probably span the range of possible atmospheres. R.N.A.

N65-25528# American Meteorological Society, Boston, Mass.
IRREGULARITY STRUCTURE AND MOVEMENT IN THE IONOSPHERE (SELECTED PASSAGES) [NEODNORODNAIA STRUKTURA I DVIZHENIE V IONOSFERE]
S. F. Mirkotan and Iu. V. Kushnerevskii Bedford, Mass., AFCRL, Dec. 1964 130 p refs Transl. into ENGLISH from Sb. Statei, Mezhduvedomstvennyi Kom. po Provedeniiu MGG, Akad. Nauk SSSR (Moscow), no. 12, 1964 p 10–32, 74–88, 109–139, 152–159
(Contract AF 19(628)-3880)
(T-RC-23; AD-613982)

Movements in the upper atmosphere which were measured by direct and indirect measurements are reported to show the presence of wind in the ionosphere. Also, simultaneous sounding of the ionosphere with radio signals of different frequencies was used to study the irregularities and movements of the ionosphere. Information on the ionosphere from different depths is reported. Further, a procedure is given for using the method of correlation analysis in ionosphere research. E.E.B.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N65-24419# Isomet Corp., Palisades Park, N. J.
DEVELOPMENT OF A CARBON DIOXIDE PARTIAL PRESSURE SENSOR Final Report, 29 Jan. 1962–15 Feb. 1964
Gerald Jankowitz and Warren Ruderman Wright-Patterson AFB, Ohio, AMRL, Dec. 1964 39 p refs
(Contract AF 33(657)-8096)
(AMRL-TR-64-140; AD-614226)

The objective was to design and develop a compact airborne CO_2 sensor unit capable of sensing and measuring the CO_2 content of manned, sealed environments. A prototype carbon dioxide sensor was designed, built, and calibrated. The sensor operates by alternately comparing the infrared absorption of the air sample at 4.26μ, where CO_2 exhibits strong absorption, and at 3.90μ where it has little absorption. A two-color rotating filter provides sampling 200 times per second. The unit weighs 10 lb and has a power consumption of 70 W. The instrument is capable of detecting a concentration of at least 0.30% CO_2 and has full scale capability to 5%. Author

N65-24486 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A SERIES OF MINIATURE MASS SPECTROMETERS FOR INVESTIGATING THE COMPOSITION OF NEUTRAL AND IONIZED GASES IN THE UPPER LAYERS OF THE ATMOSPHERE
V. A. Pavlenko, A. E. Rafal'son, and M. D. Shutov *In its* Cosmic Res. 6 Feb. 1964 p 162–174 refs (See N65-24475 14-29)

This article discusses the theory of a radiofrequency mass analyzer and explains the circuit and design of radiofrequency mass spectrometers MKh6401, MKh6403, and MKh6405 designed to investigate the ion and neutral composition of the upper atmospheric layers in the range of light (from 1 to 4 amu) and heavy (from 12 to 56 amu) masses. Examples of the use of the instruments are given along with the results of investigating upper atmospheric layers at different heights. Author

N65-24498 European Organization for Nuclear Research, Geneva (Switzerland). Div. of Nuclear Physics
USE OF LIGHTING GUIDES FOR THE ILLUMINATION OF REFERENCE METERS [APPLICATION DES GUIDES DE LUMIERE A L'ECLAIRAGE DE MARQUES FIDUCIAIRES]
J. Banaigs, J. Berger, and B. Mouëllic 30 Mar. 1965 22 p refs In FRENCH
(CERN-65-13)

The desirability of excluding all equipment subject to failure from the interior of large spark chambers and avoiding important losses of temperature and rarified gas has led to the development of a system of transmitting light along light guides to illuminate reference marks in a system exterior to the chamber. The light emitted by a source in the interior of the spark chamber is diffused from the interior surface and transmitted along the tubular guide by total reflection propagation. It arrives at the interior of a second, smaller chamber where it is diffused from the interior surface and a fraction is transmitted through an aperture in which is placed a diffusing, transparent marker through which a fraction of the incident light is emitted to a photographic apparatus and a flat photo plate. One such chamber has been successfully used in investigating the π-p diffusion at large angles. M.P.G.

N65-24568*# Parametrics, Inc., Waltham, Mass.
HIGH TEMPERATURE MEASURING DEVICE
E. H. Carnevale, L. C. Lynnworth, and G. S. Larson 1 Feb. 1965 70 p refs
(Contract NAS3-5201)
(NASA-CR-54339) CFSTI: HC $3.00/MF $0.75

Investigations of an ultrasonic pulse technique for measuring the average gas temperature in a nuclear rocket engine are presented. This includes a study of sound propagation in high temperature gases, particularly hydrogen, and the effects of the nuclear rocket engine environment on the ultrasonic sensors. A working model, designed and constructed to illustrate the concepts and operation of a pulsed ultrasonic thermometer, is also described. Author

N65-24569*# Consolidated Controls Corp., Bethel, Conn.
PRESSURE MEASURING SYSTEMS FOR CLOSED CYCLE LIQUID METAL FACILITIES Fourth Quarterly Report, 1 Dec. 1964–28 Feb. 1965
Anthony J. Cassano 5 Apr. 1965 136 p refs
(Contract NAS3-4170)
(NASA-CR-54371; CCC-486) CFSTI: HC $4.00/MF $1.00

Continuing development of a pressure transducer system for liquid metal applications is described. Fabrication and assembly of the test pressure capsules (C-129Y, FS-85, T-222 and W-25Re alloys) were completed and deflection tests utilizing an optical measurement technique concluded. Preliminary design was developed for a complete transducer instrument incorporating a thermionic diode sensor. Tests are in progress to evaluate the metal–ceramic joining techniques planned for the transducer design. A complete set of single convolution pressure capsules and electrical terminals was prepared. These test units are being charged with liquid potassium. Author

N65-24578# Aberdeen Proving Ground, Md. Ballistic Measurements Lab.
DELAYED OPENING PACKAGE FOR ROCKET AND PROJECTILE EXPERIMENTS
J. O. Pilcher, II and Simon M. Kennedy Jan. 1965 12 p
(BRL-MR-1621; AD-462983)

This report describes a cylindrical container ejected from a gun launched projectile at a high altitude which, after a predetermined time delay, releases a balloon for wind measurement. For this particular cylinder size, the time delay may be varied from 0.2 to about 4 seconds. Author

N65-24582# Army Missile Command, Huntsville, Ala. Inertial Guidance and Control Lab.
ANALYSIS AND DESIGN OF AN ACTIVE COMPENSATION NETWORK TO STABILIZE AN INERTIAL PLATFORM
Jerry L. Dooley 1 Apr. 1965 53 p refs
(RG-TR-65-4; AD-462493)

The need to improve the design and operation of ballistic missiles presents a challenge to develop inertial guidance systems of greater accuracy and reliability with miniaturized components. Advances in both design and operation areas were realized by a new method of stabilizing an inertial platform. In devising this method, which is based on active network synthesis using operational amplifiers, both open- and closed-loop analytical techniques were employed: the Bode plot and root-locus diagram for the open-loop, and closed-loop frequency response and analog system simulation for the closed-loop. Results of the analog system simulation were very close to those obtained experimentally. Author

N65-24599# Edgerton, Germeshausen and Grier, Inc., Boston, Mass.
PHOTOGRAPHIC RECONNAISSANCE TERRAIN ILLUMINANTS Technical Report, Jun. 1963–Mar. 1965
P. Bruce Newell and Allyn B. White Wright-Patterson AFB, Ohio, AF Avionics Lab., Apr. 1965 85 p
(Contract AF 33(657)-11327)
(AFAL-TR-65-102; AD-463182)

New approaches to designing terrain illuminant systems were investigated. Gas-cooling the arc discharge with high velocity injections of fill gas proved impractical. Effort was then directed toward achieving a continuous burning arc capable of reasonable life at power levels to 5 kW and a suitable tailored-beam trough reflector. In conjunction with the development of the water-cooled dc lamp, lamp configurations, spectral enhancement, heat-transfer measurements, and electrode design were also investigated. The final lamp-reflector configuration shows a greater than 5-kW capacity and has been run to 3-1/2 kW levels with the power supply used. The light output has a fairly uniform continuum throughout the visible range and several very intense, very broad lines in the infrared. About 8% of the light is in the visible (3500 to 7000 Å) and 22% in the infrared (7000 to 11000 Å) with the total conversion efficiency about 30%. Author

N65-24601# Giannini Controls Corp., Duarte, Calif.
RESEARCH TESTING OF A HYPERSONIC VELOCITY SENSING TECHNIQUE FOR AERODYNAMIC SHOCK PLASMA USING ION WAVES Final Report, Feb. 1963–Dec. 1964
J. R. Rochester Wright-Patterson AFB, Ohio, AF Flight Dyn., Lab., May 1965 160 p refs
(Contract AF 33(647)-10842)
(AFFDL-TR-65-25; AD-463161)

A velocity measurement system is studied which is of use in hypervelocity ionized gas flows. The system generates ion waves which travel with the high speed gas flow and are detected at different positions downstream from the wave source. The detectors yield transit time measurements which are directly related to the velocity of the gas flow. The system uses a pulsed magnetic field to generate the ion wave and uses a sensitive capacitance bridge to detect the propagation of the wave. The system is directed toward velocity measurements from onboard reentry missiles and spacecraft. Aerodynamic calculations are made relating the anticipated measured velocity to the free-stream velocity. Experimental evaluation of the system was accomplished by obtaining the velocity measurements in an arc-heated plasma flow. Measurements were made an M = 3 gas flow at enthalpies as high as 20000 Btu/lb. Improvements in the circuitry were made which bring the system closer to flight instrumentation. Approximate flight specifications for the system are presented. Author

N65-24603# Army Natick Labs., Mass. Clothing and Organic Materials Div.
A PHOTO-OPTICAL SYSTEM FOR THE MEASUREMENT OF PROJECTILE VELOCITY
Stanley D. Tanenholtz Oct. 1963 61 p refs
(C&OM-1; AD-426175)

A photo-optical system developed for determining the velocity of a projectile after target penetration provides a wide field of view and overcomes difficulties introduced by light from the projectile–target impact and by the pretriggering of velocity-measuring transducers of particles broken from the target. It employs a parallel-light shadowgraphic method that consists of a double-spark source at the focal point of a converging Fresnel lens, and another similar lens to focus the light into a camera. The system is activated by the projectile which, after penetrating the target, triggers a transducer whose pulse is fed to a delay unit. The delay unit in turn triggers the spark unit when the projectile is within the parallel-light field. The result is a shadowgraph of the projectile and the accompanying punchout material in two positions. The distance between the two images on the photograph (corrected by a suitable magnification factor) divided by the spark time interval gives the average velocity of the projectile. This system enables the measurement of residual velocity with an error of only 1% to 2% and, at the same time, permits the observation of size, shape, distribution of other particles, and distortion of the projectile. Author

N65-24621# Sperry Gyroscope Co., Great Neck, N. Y.
A STUDY OF REQUIREMENTS FOR A PILOT WARNING INSTRUMENT FOR VISUAL AIRBORNE COLLISION AVOIDANCE Final Report
J. Catalano and C. Mc Kown Dec. 1963 120 p refs
(Contract FAA/BRD-322)
(EB-5260-0390; RD-64-88)

Utility of information provided by operational pilot warning instruments (PWI) was studied experimentally in terms of the effect of PWI upon each stage of pilot activity occurring when a pilot is confronted by an intruder, viz., detection of the intruder, evaluation of the intruder threat, and resultant avoidance maneuver. It was found that PWI improved probability of detecting intruder aircraft. The extent of improvement was directly related to the amount of the information it provided. In addition, earlier detection, as would occur from PWI information, resulted in earlier evaluation of intruder threat and in earlier maneuvering, when necessary. Effectiveness in the operational situation would, of course, also depend upon such factors as closing rate and angle, range at detection, and aircraft maneuverability. Author

N65-24713# Weapons Research Establishment (Australia).
AN AUTOMATIC COORDINATE MEASURING EQUIPMENT
G. E. Moore and R. L. Farrell Apr. 1964 36 p refs
(WRE-TN-SAD-133)

Ballistic camera data are prepared for automatic computation by reading the plates on a comparator, and punching the image coordinates on cards. This paper describes equipment which accurately measures movements on the carriage of the comparator with respect to some fixed datum. Coordinates of images of interest are automatically displayed and punched on cards. The equipment is fully transistorized. Author

N65-24797# Hughes Aircraft Co., Culver City, Calif. Research and Development Div.
ANALYSIS OF PICTORIAL DISPLAYS Quarterly Progress Report No. 3
W. L. Carel Mar. 1965 76 p
(Contract Nonr-4468(00))
(Rept.-2732.01/25; AD-613274)

Partial solutions are presented to afford some idea of the output of the study, the scope of the work, the direction of the program, and the format that will be used to report the results. Two topics are discussed: *Pictorial Display Potential*—The greatest potential use for aircraft pictorial displays is their use for crew tasks that demand the observation of the relations between a great many inherently related variables. These tasks are observation of aircraft performance, navigation, target recognition, and tactics. *Display Requirements*—Two outputs were attempted to characterize each cell entry: (1) establish the rules by which the desired characteristics may be obtained, and (2) if an absolute value or range of values can not be stated, an example illustrating the use of the rule will be developed. R.W.H.

N65-24811# General Motors Corp., Santa Barbara, Calif. GM Defense Research Labs.
A SLITLESS SPECTROGRAPH FOR HYPERVELOCITY FREE-FLIGHT RANGE APPLICATIONS
I. D. Liu Jan. 1964 33 p refs
(Contract DA-01-021-AMC-11359(Z); ARPA Order 347; Proj. Defender)
(TR65-01B; AD-463042)

The design and construction of a large-aperture spectrograph for observing low-intensity, short-duration events in ballistic test ranges are described. The instrument is of the Bass–Kessler type modified by a slitless arrangement to improve its light-gathering power and the reproducibility of results. The spectrograph was operationally tested in an experimental program where spheres and cones of various bluntness were launched in air at velocities in excess of 20 kft/sec. Some of these models were intentionally seeded to enhance spectral radiance. The spectrograms obtained, which are presented and discussed, show good sensitivity, resolution, and consistency. Author

N65-24821# Rocky Flats Div., Dow Chemical. Co., Golden, Colo.
AN ANALYZER FOR RADIOACTIVE GAS
R. T. Merrill 11 May 1965 15 p refs
(Contract AT(29-1)-1106)
(RFP-500) CFSTI: $1.00

An instrument that can continuously monitor air for tritium has been developed. It utilizes a flow-type ionization chamber and a vibrating reed electrometer. A response of double normal background is produced by 9.4×10^{-5} $\mu c\ H^3/cc$ air; the presently accepted MPC is 2.0×10^{-5} $\mu c\ H^3/cc$ air. Its operation is completely automatic. Author

N65-24893*# Lockheed Electronics Co., Plainfield, N. J. Industrial Technology Div.
SPACECRAFT ENDLESS LOOP RECORDER Quarterly Report, 1 Jan.–1 Apr. 1965
[1965] 22 p
(Contract NAS5-3914)
(NASA-CR-62964) CFSTI: HC $1.00/MF $0.50

Design of the speed servo with substitute motor was completed. A brushless dc motor was tested. All mechanical parts were fabricated, a noncorrosive finish was applied, and a prototype transport was assembled. Author

N65-24954# Hanford Atomic Products Operation, Richland, Wash. Physics and Instruments Labs.
6144-CHANNEL TIME-OF-FLIGHT ANALYZER
R. A. Walker and J. T. Russell Sep. 1964 62 p
(Contract AT(45-1)-1350)
(HW-83480) CFSTI: $3.00

A 6144 channel time-of-flight analyzer, which accommodates signals from 12 separate detectors located around a scattering target and provides each detector with 512 channels of memory with a maximum capacity of 10000 counts per channel, is described. Each group of 512 channels is split into subgroups of 256 channels to allow data to be accumulated with the scattering target in or out of the neutron beam. The analyze, display, and readout operating modes, and the logic and circuit systems are described. Various control function definitions, a test mode, and circuit diagrams are included. R.N.A.

N65-24965# Pratt and Whitney Aircraft, Middletown, Conn.
HIGH TEMPERATURE THERMOMETRY AT PRATT AND WHITNEY AIRCRAFT-CANEL
P. Bliss and S. Fanciullo 2 Jun. 1965 48 p refs
(Contract AT(30-1)-2789)
(PWAC-462)

The development of a radiation-resistant thermocouple for temperatures up to at least 2600° F, compatible with a columbian sheath, and suitable for vacuum, gas, and lithium environments is presented. Chromel, Alumel, molybdenum, columbium, and tungsten and rhenium alloys are under consideration. Fabrication methods, with emphasis on quality control techniques, and material compatability are discussed. The thermal decalibration effects of transmutation and procedures for obtaining these data are examined. Molybdenum–columbium has shown promise at temperatures up to at least 3000° F and has stability within an accuracy of one-half percent for 10000 hours at 2000° F in limited testing. Cross-section references are encouraging. Various tables and an appendix on manufacturing specifications are included. R.N.A.

N65-24987*# Space Technology Labs., Inc., Redondo Beach, Calif. Physical Electronics Lab.
RESPONSE OF MICROPHONE METEORITE DETECTORS TO THE IMPACT OF HIGH VELOCITY PARTICLES
J. F. Friichtenicht May 1965 10 p refs
(Contract NASw-936; NAS5-763)
(NASA-CR-63126; STL-4158-6010-TU-000) CFSTI: HC $1.00/MF $0.50

The response of piezoelectric crystals to mechanical vibrations induced in the sounding board of microphone meteorite detectors by micrometeorite impact was tested. High-speed particles with impact velocities up to 7.5 kilometers per second generated from an electrostatic accelerator were used for measurements. Elastic impacts, completely inelastic impacts, and inelastic impacts enhanced by the expulsion of material from the crater which increases the momentum imparted to the crystal were considered. Results imply that the response of microphone detectors cannot be characterized as simply momentum or energy dependent. R.N.A.

N65-25063 Joint Publications Research Service, Washington, D. C.
AUTOMATIC CONTROL SCANNING PYROMETER
R. N. Blaut-Blachev *In its* The Theory and Appl of Autom. Systems 26 May 1965 p 445–458 refs (See N65-25031 14-10) CFSTI: $8.28

A scanning pyrometer was developed which can be used to determine the isothermal lines of a plane temperature field in which a reference level is introduced electrically. This device is based on a single transducer which successively measures the temperature at all points in the field. It belongs to a class of optical pyrometers in which the dependency of the sensor's photocurrent on luminous flux is described by a specified law. The fact that the scanner is sensitive to luminescence means that it can control only high temperature fields. Tests indicate that the scanning pyrometer can be used to determine the isothermal lines of a nonstationary temperature field. When the scanner's operator observes the isothermal lines on an oscillograph, he can change the operating conditions for the object radiating the field; automatic control could be effected by a device which compares the isothermal lines with a desired form for the object. J.M.D.

N65-25065 Joint Publications Research Service, Washington, D. C.
PHOTOELECTRONIC SCANNING DEVICES FOR TRACKING RADIATION SOURCES

Yu. V. Strel'nikov *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 480–492 refs (See N65-25031 14-10) CFSTI: $8.28

Detailed descriptions of two types of photoelectronic transducers for use in tracking luminescent objects are given. The manner in which these devices perform the tracking is outlined: A telescope collects the radiation flux of the object being tracked, and the radiation is focused on the surface of the photocathode of a dissector. The electrons excited by the radiation travel toward the electron multipliers. A coil focuses the electronic image of the object onto the plane of the dissector diaphragm. Deflecting voltages are applied by two pairs of coils whose magnetic fields deflect electrons in mutually perpendicular directions. This shifts the electron spot toward the plane of the diaphragm, where the displacement trajectory is determined by the time change of the deflected voltages. The signal from the dissector is compared with reference signals, and if a mismatch appears between the axis of the optical system and the direction of the object, motors are activated which move the system into a corrected position to maintain focus on the object. J.M.D.

N65-25067 Joint Publications Research Service, Washington, D. C.
AUTOMATIC DEVICE FOR SCANNING AND TRACKING LIGHT-EMITTANT OBJECTS WITH THE USE OF DIFFERENTIAL PHOTORESISTANCES
V. D. Zotov *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 507–516 refs (See N65-25031 14-10) CFSTI: $8.28

A device for automatic scanning and tracking of luminescent objects without the use of mechanical or electrical scanning is described. This is one of a class of scanners which maintain precise tracking by detecting angular mismatches of the light flux from the radiating object, causing the various sensing devices to orient themselves in several symmetric positions with respect to their optical axes. When these separate signals are compared in determining the displacement of the radiating object, the system adjusts itself accordingly. The electrical characteristics may vary from one sensor to another, which is a source of error; but the scanner described in this paper avoids this problem since the useful signal received from the sensing devices is independent of the electrical characteristics. J.M.D.

N65-25068 Joint Publications Research Service, Washington, D. C.
STRING TRANSDUCERS WITH A LINEAR CHARACTERISTIC
Yu. M. Tsodikov *In its* The Theory and Appl. of Autom. Systems 26 May 1965 p 517–524 refs (See N65-25031 14-10) CFSTI: $8.28

Differential string transducers with linear characteristics suitable for application to highly accurate industrial devices for measurement of weight, pressure, and other parameters which can be expressed as forces, are investigated. Linearization is accomplished by use of the frequency output of two strings stretched by a common force. The property of linearity makes possible the integration of the output frequency with freedom from static and dynamic errors; analysis of the difference in frequencies in the two strings indicates that errors due to nonlinearity are quite small. J.M.D.

N65-25085 General Electric Co., Palo Alto, Calif. Palo Alto Tube Operation
HARMONIC POWER METER
E. M. Mc Curry and R. H. Stone *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 160–186 refs (See N65-25075 14-07)

A technique developed for the measurement of microwave frequency multimode harmonic power in transmission lines uses the absorptive leaky-wall filter principle, low-power coaxial components, and a standard power bridge. This new type of power meter is capable of very high power operation, and it produces measurement data which are independent of the source and load impedances. The device yields data to an accuracy of ± 1 dB for the measured harmonics which can be used in the analysis of the harmonic output of high-power tubes and the response of components to multimode harmonic signals. The harmonic power meter is directly applicable to four types of uses: (1) closed system spectrum characteristic measurements, offering advantages in time and costs in implementing MIL-STD-449B; (2) production line tests of microwave tubes and components; (3) harmonic output monitoring of operating systems; and (4) the establishment of specifications and performance on prototype systems. Author

N65-25109 Fairchild Camera and Instrument Corp., Syosset, N. Y. Fairchild Space and Defense Systems
INTERFERENCE SUPPRESSION OF A HIGH PERFORMANCE TRANSISTORIZED PANORAMIC CAMERA (KA-60)
A. L. Albin *In* IIT Res. Inst. Proc. of the 10th Tri-Serv. Conf. on Electromagnetic Compatibility [1964] p 709–728 (See N65-25075 14-07)

The interference control measures incorporated in the KA-60 panoramic camera to assure compliance with MIL-I-26600 and MIL-E-6051 are described. Each subassembly was designed as an integrally interference suppressed unit for conducted interference. The camera body, magazine, and control units were designed as shielded enclosures to obtain the greatest reduction of radiated interference and susceptibility. Use was made of transistor driven relays to reduce transients. A unique miniaturized filter network of postage stamp size was designed and fabricated, providing high attenuation at low frequencies for low current applications. Author

N65-25141 Lockheed Missiles and Space Co., Palo Alto, Calif. Electronic Sciences Lab.
RESOLUTION IMPROVEMENT OF AN OPTICAL SYSTEM BY USING ROTATING RECTANGULAR APERTURES
H. P. Greinel *In its* Progr. Rept., Jan.–Mar. 1965 [1965] 10 p refs (See N65-25125 14-34)

Experiments were conducted to determine if time-varying apertures would be of value in the reduction of off-axis lens aberrations. A modified diffractometer was used to conduct the experiments. It simulated the point source at infinity by a pinhole of 0.005-inch diameter, illuminated by the condensed light of a superhigh pressure, mercury vapor lamp. The diffraction patterns in four specific surfaces of interest were recorded for inclination angles of the principal ray of incidence in the range from 0° to 35° with discrete steps of 5°. About 160 diffraction patterns of the stationary and rotating rectangular aperture were recorded. In addition, 40 exposures were devoted to the diffraction caused by a circular aperture whose area was equal to that of the slit. Results indicated that by applying time-varying apertures such as rotating slits, significant resolution improvements can be obtained, especially for off-axis point objects. E.E.B.

N65-25147# Weapons Research Establishment (Australia).
CONTROL EQUIPMENT FOR CAMERAS AND A SPECTROPHOTOMETER FOR GLOW CLOUD OBSERVATION

R. A. Sharp Mar. 1964 26 p refs
(WRE-TM-ASA-102)

To help in studying the effects of grenade explosions in the 100- to 200-km region of the upper atmosphere, photographs are taken at predetermined times, and spectra of the glow clouds produced by the grenades are recorded. A control system for operating the cameras, which uses a five-channel punched paper tape, is described together with a versatile control for the spectrophotometer. Author

N65-25161# United Kingdom Atomic Energy Authority, Culham (England). Culham Lab.
A PULSE MASS SPECTROMETER FOR STUDYING FAST PHENOMENA IN GASES AT LOW PRESSURES AND IN NON-STATIONARY PLASMAS: TECHNIQUE AND APPARATUS
V. A. Simonov and A. G. Mileshkin 1965 20 p refs Transl. into ENGLISH from Cesk. Casopis Fys. (Prague), v. 12, 1962 p 653–665
(CLM-TRANS-2) HMSO: 2s 6d

A time-of-flight pulse mass spectrometer is described—known as a chronotron—for the analysis of neutral gas over a range of pressures from 1.10^{-10} to 10 torr, or of ions in a nonstationary plasma with an ion concentration of 1.10^{8} to 1.10^{16} cm^{-3} without magnetic field, or in a strong magnetic field. Processes can be investigated of duration from 1.10^{-7} sec to continuous. Examples are given of applications of the method to the analysis of currents of molecules desorbed from solid surfaces; a study of the mechanism of sorption and of catalytic reactions on renewed surfaces using stable isotopes, the interaction of a hydrogen plasma and the walls of vacuum systems, the plasma in pulsed discharges and the passage of molecules through a highly ionized plasma. Author

N65-25169# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
A DIFFRACTION GEOMETRY SUITABLE FOR HIGH AND LOW TEMPERATURE SINGLE CRYSTAL WORK
J. F. W. Mallett and K. A. D. Lambe Jan. 1965 8 p refs
(AERE-M-1515)

Attention is drawn to an arrangement enabling single crystal specimens to be examined three dimensionally using a diffractometer, with little complication in the design of environmental control devices such as furnaces and cryostats. At least 85% of reciprocal space can be examined without physical shadowing by the apparatus, and the path length through furnace walls, is small and nearly constant. Author

N65-25181# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
A PROPORTIONAL GAS FLOW COUNTER FOR ROUTINE α- AND β-COUNTING—THE "SUGARMAN" COUNTER. PART I: DEVELOPMENT, CONSTRUCTION, AND OPERATION. PART II: SELF-ABSORPTION AND BAYHURST CURVES
J. G. Cuninghame, G. P. Kitt, M. P. Edwards, J. A. B. Goodall, C. B. Webster et al Oct. 1964 44 p
(AERE-R-4727) HMSO: 7s

The development and operation of an end-window proportional gas flow counter suitable for α- and β-counting is described. The counter has an efficiency of ~40% for a hard β-emitter and operates with a β-background of ~0.8 counts per minute with a suitable anticoincidence sheath. This part includes many experimental data which are applicable to all counters of this type and to low background β-counting in general. Data needed for the plotting of self absorption curves for 31 commonly used β-emitting nuclides are given, together with Bayhurst counter efficiency curves derived from them. Author

N65-25217# Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering
COMPUTER PROGRAMS FOR THE REDUCTION OF PHOTOGRAMMETRIC CLOUD DATA Final Report
Daniel R. Schurz and Edith Persson Jun. 1964 96 p refs
(Contract AF 19(604)-4973)
(R64-38; AFCRL-64-683; AD-431182)

The photogrammetric techniques and the computer programs used in reducing time-lapse stereophotos of cumulus cloud development to three-dimensional position information of discrete cloud points are described. The computer programs which reconstruct the tip, tilt, and swing of the cameras, convert unscaled photocoordinate and parallax measurements to scaled values, and place these values in the proper coordinate system are described. Author

N65-25240# Data Corp., Dayton, Ohio. Systems Engineering Dept.
[DEVELOPMENT OF TEST RANGE COMPONENTS FOR EVALUATING PHOTOGRAPHIC AND INFRARED IMAGE-FORMING SYSTEMS] Research Status Report No. 5, 1–30 Nov. 1964
William L. Huck 10 Dec. 1964 3 p
(Contract AF 33(615)-1433)
(MPR-64-176).

Progress is reported on the development of photographic and infrared targets for a test range as part of a test program for project AMPIRT. Four missions were successfully flown over the targets. A radiometer for recording radiation of the thermal sensitivity pad proved unsuitable for field use. Radar target positions were surveyed and mapped. Radar target fabrication is progressing on schedule. R.N.A.

N65-25246*# Parametrics, Inc., Waltham, Mass.
POTENTIAL PLANETARY ATMOSPHERE SENSORS: THE KRYPTONATE OXYGEN DETECTOR AND THE ALUMINUM OXIDE HYGROMETER Final Report
31 Dec. 1964 88 p refs Prepared for JPL
(Contract NAS7-100; JPL-950684)
(NASA-CR-63139) CFSTI: HC $3.00/MF $0.75

An investigation of the characteristics of a kryptonate oxygen detector and an aluminum oxide hygrometer to be used as planetary atmosphere sensors is presented. Indirect heating of the detector sensor requires less power than resistive heating. The Cu–Kr samples improve the oxygen sensitivity and allow a reduction in operating temperatures. A vacuum tested Cu–kryptonate sample showed no decrease in activity and retained its sensitivity to oxygen. The oxygen sensitivity range was extended by using two sensors operating at different temperatures with separate Geiger tubes monitoring each sensor. The Cu–kryptonate sensitivity to ozone could not be determined. Geiger tubes are operable after sterilization but their electrical characteristics are affected. Sterilization had no effect on hygrometer performance. Water vapor sensitivity was retained after long term vacuum exposure but a slight shift in calibrations was observed. All major hygrometer elements were able to withstand high temperatures and high vacuum. The lucite insulating layer was replaced with SiO. Elements were calibrated to frost points of −100°C and there are indications that their water vapor sensitivity extends to several orders of magnitude below this. R.N.A.

N65-25252# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
INSTRUMENTATION AND CONTROL PRACTICES IN U. S. A. REPPROCESSING PLANTS
L. A. Jobe Apr. 1965 30 p refs Presented at the Colloquy on Instrumentation in Plants for the Chem. Reprocessing of Irradiated Fuels, Paris, 22–23 Nov. 1963
(Contract AT(10-1)-205)
(IDO-14652) CFSTI: $2.00

Process variables are grouped, and the instruments develped for measuring and controlling these variables tabulated. Included in this tabulation are instruments for both in-line analytical and direct or inferential measurements. Several control loops are discussed from systems engineering standpoint. Use of data loggers and computers is discussed briefly. Author

N65-25260# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
AN EVAPORATIVE FILM CALORIMETRIC ENTHALPY PROBE
Donald E. Adams Wright-Patterson AFB, Ohio, ARL, Mar. 1965 61 p refs
(Contract AF 33(657)-7774)
(ARL-65-47; AD-615461)

The development of a calorimetric enthalpy probe utilizing an evaporating liquid film is described. The probe can operate continuously in a high-temperature environment, such as an arc. By evaporating a liquid film, the probe cools a hot gas stream to a temperature capable of being measured by conventional instrumentation. The exit temperature and composition of the gas provide the major information for an energy balance on the system. Calculation of the enthalpy of the hot gas is then possible. Several probe models, ranging in outside diameter from 0.10 to 0.050 in., were fabricated and tested. To simplify internal transpiration studies, the larger probes were separately cooled externally by forced convection. Later probes were entirely cooled by evaporating films permitting greater miniaturization. Improvements in successive probe models were implemented by studies on models utilizing separate internal and external transpiration coolant channels and by applying small diameter (0.001 in.) orifices. Analytical results which may be useful in probe design are given. An instrument for measuring the exit gas composition was developed. The described model is structurally rigid for improved stability compared to previous models. The instrument operates with an accuracy compatible with enthalpy probe requirements. Author

N65-25264# Sylvania Electric Products, Inc., Waltham, Mass. Display and Instrumentation Lab.
AN ELECTROLUMINESCENT CROSSED-GRID DISPLAY Final Report, 4 Jun. 1963–4 Jun. 1964
Joseph Hallett Griffiss AFB, N. Y., RADC, Mar. 1965 81 p
(Contract AF 30(602)-3081)
(RADC-TR-64-362; AD-615505)

Organization and performance of an electroluminescent crossed grid display system were studied and an experimental model was constructed demonstrating basic concepts developed. Work is based on a display panel that does not have integral storage; a buffer memory is included to minimize the load on the computer data-source, and to periodically refresh displayed information. It is indicated that an image-organized magnetic core memory is most suitable for this system. Semiconductor and magnetic circuits were investigated for driving the display, and magnetic circuits were found to provide superior performance and advantages. An improved technique for display panel construction permits construction of a large display surface from a number of individual modules. The experimental model has an 8 in. by 8 in. display with 16-line per inch resolution. An image may be erased and replaced with a new one in less than one frame (1/30 second). Brightness, about 0.8 footlamberts for an average contrast ratio of about 20:1, is independent of density of displayed information. Techniques used are compatible with future use of light amplifiers or improved EL materials to provide increased brightness. Author

N65-25311# Weapons Research Establishment (Australia). Dept. of Supply
AN INVESTIGATION OF A 3 CM INTERFEROMETER AERIAL SYSTEM FOR MEASURING MISSILE ATTITUDE
J. R. Pyle Mar. 1965 36 p ref
(WERE-PAD-101)

A proposed 3-cm interferometer aerial system (to be used in a system for measuring missile attitude) was investigated to see whether its radiation pattern behaves in a predictable manner. The effect of a nearby low frequency aerial mounted at the mock missile body was examined also. The results indicate that the proposed aerial system will provide reliable information leading to an accurate measurement of missile attitude especially if the particular missile type is calibrated first. Author

N65-25313# Canadian Armament Research and Development Establishment, Valcartier (Quebec).
DESCRIPTION OF A PROGRAMMER USED FOR ROCKET MOTORS STATIC TESTS
R. Demers and F. Crepault Feb. 1965 20 p
(CARDE-TN-1632/65)

A programer is described which facilitates the operations involved in prefiring, firing, and postfiring of rocket motors during static firing tests. The programer uses several cams mounted on shafts driven by synchronous motors with interchangeable gear trains allowing the rotation to vary from 10 seconds to 6 minutes. Each cam operates a microswitch which activates an instrument. Slow cams are used to operate a tape recorder, several oscillographs, cameras, and a warning horn. Rapid cams are employed for ignition circuits, single shot cameras, water injectors, etc. R.N.A.

N65-25321# Frankford Arsenal, Philadelphia, Pa. Research and Development Directorate
INFINITY REFLEX SIGHT
Donald R. Furmanski and Gordon Sigman Apr. 1965 22 p
(T-65-6-1)

The design and development of a universal pilot sight (sight, infinity reflex) for the helicopter armament program are described. The sight provides an aiming reference for the helicopter pilot; it is compatible with weapon systems M3, XM5, M6, XM16, and can be easily adapted to similar systems. Author

N65-25322# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
IMAGE MOVEMENT AND RESOLVING POWER
G. Voss 9 Apr. 1965 6 p refs Transl. into ENGLISH from a publ. of VEB Carl Zeiss (Jena), p 1–3
(FTD-TT-65-244/1+2; AD-461208)

The taking of aerial photographs with different amounts of image movement by varying the exposure time and flying height, is discussed. Determination of resolution by means of 3-line targets, placed on the terrain. Determination of the function of resolution, on image movement by means of an empirical diagram. Author

N65-25323# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A METHOD OF DETERMINING IMAGE MOVEMENTS THAT OCCUR IN AERIAL SURVEY CAMERAS UNDER FLIGHT CONDITIONS
Guenther Voss 16 Apr. 1963 17 p refs Transl. into ENGLISH from a publ. of VEB Carl Zeiss (Jena), 8 p
(FTD-TT-65-245/1+2; AD-461641)

After a general reflection of all kinds of image migration occurring in an aerial survey camera, a method is determined for angular rotary oscillations. The light track produced in the image and caused by a mercury vapor lamp is photographed from the air at night with the shutter permanently open, and then evaluated by means of a coordinate measuring instrument. After having made the necessary reductions, the measuring values are plotted as an oscillation curve from which the frequencies and amplitudes may be taken. Author

N65-25348*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ANALYSIS OF WIND TUNNEL DATA FOR SEVERAL BECKMAN AND WHITLEY SERIES 50 AND CLIMET MODEL C1-14 ANEMOMETERS
Dennis W. Camp 26 May 1965 44 p refs
(NASA-TM-X-53271) CFSTI: HC $2.00/MF $0.50

This report presents results of wind tunnel test data for several Beckman & Whitley Series 50 and Climet Model C1-14 anemometers. The primary purpose of the wind tunnel testing was the determination of the following two response parameters: the distance constant and the damping ratio of the anemometers. The dependence of the distance constant on the electronic filter used to filter the output signal of the wind speed sensor is discussed. The importance of the distance constant in measuring the fluctuations of the wind is illustrated by showing how this parameter affects the frequency response curves of the anemometers. Author

N65-25351# Royal Aircraft Establishment, Farnborough (England).
SOME MEASUREMENTS ON THERMOCOUPLES SUBJECTED TO RADIATION
A. C. Ham and R. E. Jones London, Min. of Aviation, Oct. 1963 16 p refs
(RAE-TN-STRUCT-343)

The effect of radiation of up to 10 kW/ft^2 intensity on the accuracy with which 33 s.w.g. chromel-alumel thermocouples can be used to measure the surface temperature of mild steel sheets is examined. The error increases with radiation intensity, and under the conditions of the experiments was found to be about 0.3° C per kW/ft^2. Author

N65-25368 United Kingdom Atomic Energy Authority, Harwell (England). Nuclear Physics Div.
CRYSTAL GONIOMETER AND PROGRAMMING UNIT
G. Peckham Jul. 1964 9 p ref
(AERE-M-1425)

The crystal goniometer and programing unit allow orientation of a single crystal sample in a neutron scattering experiment to be automatically changed. Many angles may be set up in advance on a patchboard, and the crystal advanced from one to the next by a signal from another unit. Automatic control changes the crystal angle about one axis. Manual adjustment is provided about two axes at right angles to this. Author

N65-25408*# Beckman Instruments, Inc., Fullerton, Calif. Space Engineering Dept.
INFRARED SPECTROMETER CALIBRATION MONOCHROMATOR STUDY Final Report
B. D. Henderson and J. Zeruchs [1965] 94 p Prepared for JPL
(Contracts NAS7-100; JPL-950974)
(NASA-CR-63183) CFSTI: HC $3.00/MF $0.75

The development of a calibration monochromator for measuring the quantitative performance of infrared spectrometers used in space is discussed. The calibration monochromator design, methods of optically coupling the calibration monochromator to the multidetector monochromator, and its entrance optics are discussed. An appendix examines design requirements for an optimum optical system including the high degree of resolution needed, the stray energy characteristics of the system, and the environmental conditions under which the monochromator must operate. R.N.A.

N65-25524# American Meteorological Society, Boston, Mass.
CALIBRATION OF RADIOSONDES AT TEMPERATURES TO MINUS 100°C [GRADUIROVKA RADIOZONDOV DO TEMPERATURY MINUS 100°]
A. E. Shchekin Bedford, Mass., AFCRL, Nov. 1964 9 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), v. 26, no. 6, 1964 p 49-51
(Contract AF 19(628)-3880)
(T-R-458; AD-613979)

For the purpose of calibrating radiosondes used for measurements in the upper troposphere and the stratosphere in the equatorial and arctic regions, methods have been developed for cooling alcohol and toluene to −95° to −100° C and for checking the readings of test thermometers at these temperatures against reference points. These methods are based on the familiar relationship between the sublimation point of dry ice and the external pressure. C.L.W.

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N65-24413# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH-SPEED CLOSED-IMPRESSION DIE FORGING
Yu. P. Sogrishin, O. V. Protopopov, and Yu. N. Nikolenko 29 Jan. 1965 13 p refs Transl. into ENGLISH from Kuznechno-Shtampovochnoye Proizv. (USSR), no. 3, 1964 p 11-16
(FTD-TT-64-815/1+2; AD-610661)

An analysis of the advantages and inherent problems in using the high speed closed impression die forging method is presented. Included is a discussion of several groups into which forgings stamped out by the high speed method may be classified, the precision of the transverse and longitudinal dimensions of the stamped out forgings, deviations in the forgings, the radii of the roundings (both inside and out), the radii of the roundings (both in the direction of the blow and at an angle), the macro- and microstructure of forgings stamped out at high speed, the stamping out of forgings from cylindrical

billets, pretreatment techniques for increasing surface precision and quality, lubricants for stamping out heat-resistant and titanium alloys, the selection of optimum conditions of forging as influenced by energy capacity and specific pressures, and the optimum speeds of the processes of high speed shaping of metals. S.C.W.

N65-24415# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RESULTS OF AZNII NP OPERATION IN THE FIELD OF SYNTHESIZING, STUDYING AND APPLICATION OF ADMIXTURES TO LUBRICATING OILS
A. M. Kuliyev 28 Jan. 1965 13 p Transl. into ENGLISH from Tr. Tret'tey Vsesoyuznoy Konf. po Treniyu i Iznosu V Mashinakh (USSR), v. 3, 1960 p 366–373
(FTD-TT-64-860/1+2; AD-610651)

An analysis of research focuses on the technological development of additives for improving the quality of lubricating oils is presented. Data are included on the synthesis of depressant additives for reducing the freezing point of oils; the synthesis of multifunctional additives including sulfonate, alkylphenyl, combined, and complex action additives; the synthesis of additives which increase the strength of oily films and improve their lubricating qualities; the synthesis of stabilizing additives; and the susceptibility of oils and individual groups of hydrocarbons to various additives. S.C.W.

N65-24416# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTROLYTIC METHOD OF BRASS PLATING STEEL WIRE
N. V. Sokolov, G. G. Burkov et al 22 Jan. 1965 3 p Transl. into ENGLISH from Soviet Patent No. 150727 (Application No. 751082/22-2, 10 Nov. 1961) 2 p
(FTD-TT-64-866/1; AD-610652)

An electrolytic method of brass plating steel wire with subsequent thermal treatment is proposed. The method consists of coating the initial predegreased wire with copper from a pyrophosphate electrolyte, then with zinc from a sulfate electrolyte, after which it is subjected to firing between 420° to 550°. The primary objectives of the method are to obtain a more uniform composition of the brass after firing. S.C.W.

N65-24453# Whittaker Corp., San Diego, Calif. NARMCO Research and Development Div.
INTERLAMINAR SHEAR OF FILAMENT-WOUND REINFORCED PLASTICS Quarterly Progress Report, 1 Jan.–31 Mar. 1965
Jim Keogh Apr. 1965 15 p
(Contract N60921-7094)
(QPR-6; AD-613997)

The objective is to improve the interlaminar shear strength of filament-wound composites. Efforts were directed toward fabrication of fiber glass reinforced plastic cylinders high in interlaminar shear. Author

N65-24466 Joint Publications Research Service, Washington, D. C.
CENTRIFUGAL LABORATORY PUMPS FOR TRANSFERRING LIQUID METALS
A. A. Andreyevskiy and D. M. Kalachev *In its* Liquid Metals in Met. 4 May 1965 p 18–24 refs (See N65-24463 14-17) CFSTI: $2.00

Designs of laboratory liquid-metal centrifugal pumps of the type TsND-6 were developed and tested under conditions of prolonged operation (6000 hr) at temperatures up to 650° C. Comparative tests of the pump for water and a heavy metal confirmed the possibility of obtaining the pressure characteristics of the pumps from the water tests. The maximum pressure of the pump (at 1600 rpm) was 16 m of a liquid column, and the output of the pump attained 10 to 12 m/hrs. Due to the absence of parts subject to wear (sealing bushings and rings) in the working part of the pump, the hydraulic characteristics did not change. A 14-kilowatt dc electric motor of the type P-62 was used. The overall efficiency of the unit depending upon expenditure and rpm varied within the limits of 15% to 27%, which is acceptable for laboratory-type pumps. N.E.A.

N65-24467 Joint Publications Research Service, Washington, D. C.
MERCURY GEAR PUMP
L. I. Gel'man, A. N. Gasilovskiy, and I. Z. Kopp *In its* Liquid Metals in Met. 4 May 1965 p 25–31 refs (See N65-24463 14-17) CFSTI: $2.00

The design and testing of a mercury gear pump with the following parameters—capacity 30 m/hr, pressure 25 kg/cm^2—is presented. The pump has a steel body with a cover and two cylindrical gears 70 mm in diameter. The normal modulus is m = 3.5; the number of the teeth z = 18; the width of a tooth b = 70 mm. The efficiency of the pump was tested with cold mercury. To obtain the characteristics of the pump its theoretical output was determined from the Yudin formula. The basic results of the experiments, the results of the calculations of the theoretical output from the formula, and the magnitude of the leakage are presented in tabular form. It is concluded that the pump showed satisfactory efficiency and conformity to the desired requirements. The leakage of mercury into the environment was not observed during the operation of the pump. N.E.A.

N65-24614# Atomic Energy Commission, Germantown, Md. Div. of Technical Information
NONDESTRUCTIVE TESTING
Harold Berger Apr. 1965 42 p refs

This booklet in the series entitled "Understanding the Atom" is designed to acquaint the layman with the contemporary and future role of nuclear energy and focuses on nondestructive testing. A synopsis of the principles of nondestructive testing and nondestructive testing methods, such as radiation techniques, ultrasonic methods, and penetrant techniques is included. The future prospects of nondestructive testing are discussed in respect to such new methods as ultrasonic imaging and neutron radiography. S.C.W.

N65-24626*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE TECHNOLOGY. VOLUME II: SPACECRAFT MECHANICAL ENGINEERING
James L. Adams Washington, NASA, 1965 169 p ref Prepared for course in Space Technol. given by Calif. Inst. of Technol., 19 Jun.–31 Jul. 1964
(Grant NsG-598)
(NASA-SP-66) GPO: $0.60; CFSTI: MF $1.00

This publication contains notes prepared for a course on spacecraft mechanical engineering, given by the California Institute of Technology in cooperation with the Jet Propulsion Laboratory. Included are synopses of basic structural

theory, structural materials, computers and testing analyses, spacecraft structures, temperature control theory, spacecraft temperature control theory and testing, spacecraft temperature control, mechanism theory, bearings and lubrication, spacecraft mechanisms, electronic packaging, and spacecraft electronic packaging. S.C.W.

N65-24639# Pisa Univ. (Italy). Machine Inst.
THE REDUCTION OF THE MANUFACTURING COSTS THROUGH THE REDUCTION OF TIME AT A MACHINE [LA RIDUZIONE DEI COSTI DI FABBRICAZIONE ATTRAVERSO LA RIDUZIONE DEI TEMPI-MACCHINA]
Bruno Bartalucci [1963] 21 p In ITALIAN *Its* 21st Ser., No. 1035

Examples of cost reduction, highlighting the use of appropriate materials and high efficiency use of machinery, are given. Transl. by P.F.E.

N65-24640# Pisa Univ. (Italy). Inst. of Applied Mechanics and Aeronautics
ON THE ELASTIC SLIPPING IN THE ROLLING OF SHAPES OF VARIOUS MATERIALS [SULLO SLITTAMENTO ELASTICO NEL ROTOLAMENTO DI CORPI DI MATERIALI DIVERSI]
Marino Marini 1964 19 p refs In ITALIAN *Its* 21st Ser., No. 1044

Elastic slipping and friction couplings between rollers or drums made of rubber and steel, perspex and steel, and aluminum and steel are examined. Transl. by P.F.E.

N65-24655*# Whirlpool Corp., St. Joseph, Mich. Systems Div.
DEVELOPMENT OF FLEXIBLE FOAMED FILLED STRUCTURES Final Report
Arthur E. Benford 8 Dec. 1964 41 p
(Contract NAS9-2031)
(NASA-CR-65013) CFSTI: HC $2.00/MF $0.50

The development of a small static foam machine and a foam formulation for inflating a one-man life raft is described. The basic design consists of two pressure tanks containing two foaming materials, a two-way valve, and a static mixing area which produces a stable rigid foam. Foam formulation aging and settling tests showed no unfavorable characteristics. Photos are used to describe the foam machine assembly. R.N.A.

N65-24675# Tohoku Univ., Sendai (Japan).
BULLETIN OF THE RESEARCH INSTITUTE FOR SCIENTIFIC MEASUREMENTS, VOL. 11, NO. 2-3
Jan. 1963 128 p refs In JAPANESE; ENGLISH summary

CONTENTS:

1. STUDIES ON THE PULVERIZING OF CRYSTALLINE GRAPHITE Ryoji Aita and Kunio Yoshida p 121–139 refs (See N65-24676 14-15)

2. ON THE SHAPE OF PARTICLE OF NATURAL GRAPHITE PULVERIZED BY THE CUTTER MILL Ryoji Aita and Kunio Yoshida p 141–160 (See N65-24677 14-15)

3. ABOUT THE MOTION OF BALLS, MILL CHARGE AND THEIR PULVERIZING EFFECT IN THE BALL MILL Ryoji Aita and Kunio Yoshida p 161–188 refs (See N65-24678 14-15)

4. THE EDGE DISLOCATION AND CRYSTAL GROWTH OF CdS CRYSTALS Jiro Nishimura (Iwate Univ.) p 189–203 refs (See N65-24679 14-26)

5. THE VARIATION OF ELECTRIC RESISTANCE OF CdS AND ZnS CRYSTALS UNDER IRRADIATION WITH X-RAY Jiro Nishimura (Iwate Univ.) p 205–226 refs (See N65-24680 14-26)

6. PULVERIZING OF NATURAL GRAPHITE PARTICLE BY HAMMER MILL Ryoji Aita and Kunio Yoshida p 227–234 (See N65-24681 14-15)

7. STUDY ON THE DIELECTRIC ANOMALIES PRODUCED BY THE PHASE TRANSITION Kan-Ichi Kamiyoshi, Tadao Fujimura, and Tsutomu Yamakami p 235–248 refs (See N65-24682 14-26)

N65-24676 Tohoku Univ., Sendai (Japan).
STUDIES ON THE PULVERIZING OF CRYSTALLINE GRAPHITE
Ryoji Aita and Kunio Yoshida *In its* Bull. of the Res. Inst. for Sci. Meas., Vol. II, No. 2-3 Jan. 1963 p 121–139 refs (See N65-24675 14-15)

A comparative study of the pulverizing processes of crystalline graphite induced by the ball mill, stamp mill, and cutter mill methods, which emphasizes the size distribution of pulverized products of graphite, the size distribution of accumulated particles consisting of mixtures of large and small graphite crystals, and the shape of particles of pulverizing products, is reported. Included are examples of the pulverizing process of graphite grains by wedge-, plane-, and sphere-type solid bodies. Author

N65-24677 Tohoku Univ., Sendai (Japan).
ON THE SHAPE OF PARTICLE OF NATURAL GRAPHITE PULVERIZED BY THE CUTTER MILL
Ryoji Aita and Kunio Yoshida *In its* Bull. of the Res. Inst. for Sci. Meas., Vol. II, No. 2-3 Jan. 1963 p 141–160 (See N65-24675 14-15)

The pulverizing action of the cutter mill was used to shear the flakes of natural graphite so that the pulverized particles would resemble the same flat flake shape as that of natural graphite. Using this method resulted in particles deformed to spherical shape. A study of the cause of deformation showed that natural graphite particles were colliding with the wall of the cutter mill body. Author

N65-24678 Tohoku Univ., Sendai (Japan).
ABOUT THE MOTION OF BALLS, MILL CHARGE AND THEIR PULVERIZING EFFECT IN THE BALL MILL
Ryoji Aita and Kunio Yoshida *In its* Bull. of the Res. Inst. for Sci. Meas., Vol. II, No. 2-3 Jan. 1963 p 161–188 refs (See N65-24675 14-15)

A comparative study of the pulverizing effects of the ball mill on crystalline graphite and on sand, which is designed to improve graphite pulverization techniques, is presented. Reported are results of experiments emphasizing the effects of the change of mill speed and mill charge by a laboratory scale ball mill. To eliminate interference caused by mill change motion, lifters were employed. Good pulverizing effects were achieved for a 70% to 75% mill charge (ball and graphite) to mill volume. Author

N65-24681 Tohoku Univ., Sendai (Japan).
PULVERIZING OF NATURAL GRAPHITE PARTICLE BY HAMMER MILL
Ryoji Aita and Kunio Yoshida *In its* Bull. of the Res. Inst. for Sci. Meas., Vol. II, No. 2-3 Jan. 1963 p 227–234 (See N65-24675 14-15)

A study of the pulverizing effect of the hammer mill on natural graphite particles is reported. Included are data on particle shape and size distribution. S.C.W.

N65-24683# Tohoku Univ., Sendai (Japan).
BULLETIN OF THE RESEARCH INSTITUTE FOR SCIENTIFIC MEASUREMENTS, VOL. 12, NO. 1
Nov. 1963 54 p refs In JAPANESE; ENGLISH summary

CONTENTS:

1. THE APPARATUS FOR GRINDING OPTICAL SURFACES WITH ASPHERICAL CONFIGURATION Koro Shishido p1–18 refs (See N65-24684 14-15)

2. THE FABRICATION OF OPTICAL SURFACES WITH ASYMMETRICAL AND ASPHERICAL CONFIGURATION Kori Shishido p 19–29 refs (See N65-24685 14-15)

3. THEORETICAL CONSIDERATION ON ENERGY CONCENTRATION RATIO, CONCENTRATION EFFICIENCY AND OBTAINABLE TEMPERATURE OF SOLAR FURNACE. I. FLAT TARGET Osamu Kamada p 30–44 refs (See N65-24686 14-03)

4. STUDY OF DYNAMIC LOAD ON HELICAL GEAR TEETH (1ST REPORT). LOAD DISTRIBUTION ON THE CONTRACT LINE OF HELICAL GEAR TEETH Saburo Takanashi and Shigeru Yamashita p 45–54 refs (See N65-24687 14-15)

N65-24684 Tohoku Univ., Sendai (Japan).
THE APPARATUS FOR GRINDING OPTICAL SURFACES WITH ASPHERICAL CONFIGURATION
Koro Shishido *In its* Bull. of the Res. Inst. for Sci. Meas., Vol. 12, No. 1 Nov. 1963 p 1–18 refs (See N65-24683 14-15)

The construction of a machine which grinds aspherical surfaces is described. To make a tool trace the profile of the required surface, a device by means of a cam has been developed. In the test, a paraboloidal mirror 275 mm in focal length and 300 mm in aperture, which would be used in infrared spectrophotometers by segmentation, was ground with sufficient accuracy. Author

N65-24685 Tohoku Univ., Sendai (Japan).
THE FABRICATION OF OPTICAL SURFACES WITH ASYMMETRICAL AND ASPHERICAL CONFIGURATION
Koro Shishido *In its* Bull. of the Res. Inst. for Sci. Meas., Vol. 12, No. 1 Nov. 1963 p 19–29 refs (See N65-24683 14-15)

A method for fabricating a surface which is asymmetrical and also aspherical is presented. Such a surface is required for a lens which will be used in printing color spots in a phosphor screen of the television kinescope. The glass blank is ground by a revolving diamond tool. In order to give a required motion to the tool, a combination of cam systems was devised. The result of the fabrication is given. Author

N65-24687# Tohoku Univ., Sendai (Japan).
STUDY OF DYNAMIC LOAD ON HELICAL GEAR TEETH (1st REPORT) LOAD DISTRIBUTION ON THE CONTACT LINE OF HELICAL GEAR TEETH
Saburo Takanashi and Shigeru Yamashita *In its* Bull. of the Res. Inst. for Sci. Meas., Vol. 12, No. 1 Nov. 1963 p 45–54 refs (See N65-24683 14-15)

To study the dynamic loads on helical gear teeth, the load distribution on the contact line of helical gear teeth was investigated. The data of test helical gear are as follows: normal module, $M_n=9$; number of pinion teeth, $Z_1=24$; number of gear teeth, $Z_2=29$; normal pressure angle, $a_n=20°$ face width, b=30 mm; helix angle, $\beta=29°40'$; pinion material, S 45 C Steel; and gear material, Bakelite. The amount of deflection of pinion tooth δ_P and gear tooth δ_G was measured by experimental method. The amount of approach of gear teeth at the contact δ_H was calculated by Lundberg's formula. The load distribution on the contact line of helical gear teeth was calculated under an assumption that the total deflection $(\delta_P+\delta_G+\delta_H)$ is quite equal at any point of the contact line. The relation between the total amount of deflection and the total load on gear teeth was obtained. By using this research, the load distribution ratio of helical gear teeth can be obtained. Author

N65-24699# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
CONFIDENCE LIMITS FOR SYSTEM RELIABILITY BASED ON COMPONENT TEST DATA
Oscar Albert Bernhoff (M.S. Thesis) Aug. 1963 88 p refs
(GRE-MATH-63-1; AD-425849)

The determination of system confidence limits for reliability by the Monte Carlo simulation technique is discussed. The procedure consists of sampling the estimator's distributions for dissimilar probability distributions to obtain a sample point of the estimator distribution repeatedly until the system probability distribution is adequately simulated. One thousand and sixty sample points will give a 99% confidence that the simulated distribution does not differ from the analytical distribution by more than 0.05. It was concluded that system reliability confidence limits can be obtained by (1) combination of all component reliability estimators for parameters that have the same mathematical form; (2) substitution of the confidence limits of the estimated parameter into the system reliability estimator function if it is the function of one term; and (3) the application of the Monte Carlo simulation method to approximate the distribution of the system reliability estimator if it is the function of two or more dissimilar terms. G.G.

N65-24712# United Aircraft Corp., Windsor Locks, Conn. Hamilton Standard Div.
ELECTRON BEAM TECHNIQUES FOR FABRICATION AND ASSEMBLY OF PARTS FOR ELECTRON TUBES
Quarterly Report No. 1, 1 Jul.–30 Sep. 1963
John F. Dudenhoefer [1963] 63 p ref
(Contract DA-36-039-AMC-03625(E))
(ERB-127; AD-425878) CFSTI: $1.75

Purposes of the program are outlined, and fundamentals of the electron beam process, including its advantages over more conventional techniques, discussed. Materials procured for developmental testing are listed. Configurations to be evaluated are presented, those welded to date, are tabulated. Evaluation procedures established are presented. Progress in applying electron beam processing to electron tube fabrication is discussed. Author

N65-24740# Joint Publications Research Service, Washington, D. C.
ELECTROSLAG WELDING
24 May 1965 75 p refs Transl. into ENGLISH from the book "Tekhnologiya Svarochnogo Proizvodstva" Moscow-Leningrad, 1964 p 152–188, 288–298
(JPRS-30211; TT-65-31060) CFSTI: $3.00

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N65-24741 Joint Publications Research Service, Washington, D. C.

ELECTROSLAG WELDING OF DISSIMILAR STEELS

A. I. Rumkevich and A. S. Gel'man *In its* Electroslag Welding 24 May 1965 p 1–23 refs (See N65-24740 14-15) CFSTI: $3.00

Research results are reported on the electroslag welding of dissimilar steels used in making radial axial power wheels for large hydroturbines which operate under conditions of cavitation or corrosion/abrasive wear. Two approaches to the problem are considered: the use of a high alloyed electrode wire with raised content of the alloying element, and the use of low carbon wire in which the alloying of the seam occurs primarily as a result of its dilution by the base high alloyed metal. Three variants of welding steels to obtain a high alloyed metal seam were studied. The basic differences between these methods in respect to impact strength, plasticity, hardness, and yield point of the seam are discussed. Data are included on dispersion hardening techniques, the mechanical properties of steel–copper ingots, and criteria for use in selecting such filler materials as nickel and molybdenum. S.C.W.

N65-24742 Joint Publications Research Service, Washington, D. C.

ARC AND ELECTROSLAG WELDING OF AUSTENITIC–FERRITIC STEELS

A. S. Gel'man, T. S. Gonserovskaya, A. I. Rymkevich, and V. M. Vasyakov *In its* Electroslag Welding 24 May 1965 p 24–54 (See N65-24740 14-15) CFSTI: $3.00

An analysis of the arc welding technique for use in the development of cavitation and erosion resistant steel and in the manufacture of welded cast power wheels of hydroturbines; and an investigation of the feasibility of electroslag welding austenitic–ferritic steels for use in the manufacture of thick walled parts of large radial-axial and revolving blade hydroturbines, is presented. By using massive plates, and modeling the actual welded structure of power wheels and permanent turbine parts, the possibility of arc welding steel without preheating with electrodes was confirmed. It is also shown that austenitic–ferritic steel can be welded with electroslag welding in the cast and in the forged state, using wire or laminar electrodes, or a melting sheath. Normalization and double tempering after welding is recommended to produce quality joints. Data are included on mechanical properties, erosion resistance, microstructure, and chemical composition, of test austenitic–ferritic steels before and after welding. S.C.W.

N65-24756# Autonetics, Downey, Calif. Navigation Systems Div.

A SIMPLIFIED METHOD OF VARIABLES SAMPLING

Louis J. Schneider 1 Apr. 1965 23 p refs Revised

Unknown standard deviation plans based upon the sample mean and the sample standard deviation are presented for variables sampling. They involve measurement of lot quality by percent defective and are useful in destructive testing situations where use of variables is mandatory. The sampling plan consists of sample size, a method for estimating the percent defective, and an estimated maximum allowable percent defective. Typical examples illustrating the use of the sampling procedures, tables for inspection by variables for percent defectives, and the simplified method are presented. G.G.

N65-24834# General Electric Co., Schenectady, N. Y. Research Lab.

INVESTIGATION OF THE NATURE OF STRUCTURAL DAMAGE IN METAL-FORMING PROCESSES Quarterly Report, 19 Oct. 1964–18 Jan. 1965

H. C. Rogers, R. C. Leech, and L. F. Coffin, Jr. Feb. 1965 13 p ref

(Contract NOw-65-0097-f)

(QR-1; AD-612255)

Studies on the way in which hydrostatic stresses influence the initiation and propagation of failure in materials are continued. The work performed during this period falls into four areas: development of high-pressure fluid facilities; development of high precision density measuring facilities; further ambient pressure sheet drawing; and lubrication and die friction studies. These are described in detail. N.E.A.

N65-24950*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

1964 PUBLICATIONS

30 Jan. 1965 22 p

(NASA-TM-X-53191) CFSTI: HC $1.00/MF $0.50

Papers written at the Center in 1964 by personnel of the Materials Division, Propulsion and Vehicle Engineering Laboratory, are listed and abstracted. Author

N65-24960# Bell Helicopter Co., Fort Worth, Tex.

EFFECT OF EROSION RESISTANT BOOTS ON UH-1B/D TAIL ROTOR BLADES

Frank B. Burpo and Ernest C. Darlington Ft. Eustis, Va., Army Transporttion Res. Command, May 1965 45 p

(Contract DA-44-177-AMC-252(T))

(BHC-299-099-276; TRECOM-TR-65-22; AD-615464)

The results of a flight test program conducted to evaluate erosion boots installed on the outboard 18 inches of the UH-1 helicopter tail rotor blades are presented. The effect of the boot installation on the balance, operation, and fatigue life of the UH-1B/D tail rotor dynamic components is described. Loads as measured during flight tests of the tail rotor with the boots installed are compared to loads measured using a standard tail rotor. In both the balanced and unbalanced conditions no detrimental effects were encountered. The oscillatory loads recorded in either condition would not cause fatigue damage, and no problems in operation were obtained with the boots installed. Author

N65-24978*# SKF Industries, Inc., King of Prussia, Pa. Research Lab.

SUPERSONIC TRANSPORT LUBRICATION SYSTEM INVESTIGATION Monthly Progress Report, No. 4, 1–28 Feb. 1965

R. Cheers, F. Cook, C. Hingley, H. Mahncke, R. Prewitt et al [1965] 29 p

(Contract NAS3-6267)

(NASA-CR-63121) CFSTI: HC $2.00/MF $0.50

Progress is reported on the performance evaluation of gas turbine mainshaft ball bearings, seals, and lubricants under simulated supersonic transport engine conditions as components of an oil circulating and an oil mist system, each with

inert gas blanketing for high-temperature lubrication. The hot-air system has been delayed because of design problems. Fluid systems for the recirculating oil rig are ready for construction. Design of instrument panels, drive shafts, and mounting tables are near completion. The special disassembly tools for removing the bearings are being designed. Tests on the experimental housing fixture did not yield the expected flexibilities. A new specimen in the form of a gimbal is being constructed. The remaining fluid to be selected for the circulating oil tests is being reviewed. R.N.A.

N65-24988*# Manitowoc Shipbuilding, Inc., Wis.
[SPIDER ASSEMBLY DESIGN AND FABRICATION] Final Report
23 Apr. 1965 19 p
(Contract NAS8-11577)
(NASA-CR-63125) CFSTI: HC $1.00/MF $0.50

Presented are welding procedures for a new spider assembly, with the following design and fabrication requirements considered: (1) All friction joint surfaces of T_1 steel should be machined flat. (2) The subassembly should not be machined prior to complete assembly. (3) All root and next-to-last weld passes are to be magnafluxed. (4) All material should be laid out prior to burning. (5) Lamp fixtures should be used for preheating. The weld joint design and procedures developed for the above weldments are also included. G.G.

N65-24989*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LIQUID OXYGEN SEAL INVESTIGATION Status Report
James E. Curry 16 Dec. 1964 36 p refs
(NASA-TM-X-53183) CFSTI: HC $2.00/MF $0.50

The purpose is to develop an improved gasket material for liquid oxygen applications. Several proprietary fluorocarbon materials were investigated, but no single parameter or relationship could be established as a true index of cryogenic seal performance. Parallel studies have resulted in the development of a laminated gasket construction consisting of alternating layers of glass fabric and fluorocarbon film. The material is then compressed and heated to cause partial wetting of the glass fabric by the fluorocarbon resin. The unique properties of these laminates are discussed in detail, and data are presented that indicate an attractive future for these materials as general-purpose cryogenic seals. Author

N65-25006*# General Electric Co., Schenectady, N. Y. Advanced Technology Labs.
DEVELOPMENT OF LOW TEMPERATURE DIELECTRIC COATINGS FOR ELECTRICAL CONDUCTORS Fifteenth Quarterly Report
R. N. Mathes 15 Apr. 1965 33 p
(Contract NAS8-2442)
(NASA-CR-62895) CFSTI: HC $2.00/MF $0.50

Tests on a modified cryogenic connector indicate that to assure reasonable resistance to penetration of moisture, silicone oil must be applied to both back faces where the wires enter the connector; however, a complete seal has not been achieved, probably due to small creepage distances between conductors at the interface between the male and female parts. A cryogenic connector design is presented which makes use of the compression between elastomeric and rigid parts and provides relatively long interfacial creepage distances so that silicone oil is not needed to obtain a moisture seal. A major source of variations in conductor resistance through the modified cryogenic connector was found to be the variation in spring tension of the female connector. Use of a microflame oxygen–butane torch, adaptable for field use, performed effectively in removing polyamide insulations, and when used to produce a small flame, it is effective in removing ML enamel. J.M.D.

N65-25148# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
CERAMICS Research and Development Quarterly Progress Report, Oct.–Dec., 1964
D. J. Kessel 21 May 1965 25 p
(Contract AT(29-1)-1106)
(RFP-518)

Mononitrides of aluminum, titanium, and zirconium, as well as titanium carbide and yttrium oxide were pressure-sintered several times with a small graphite crucible forming die. Titanium and zirconium mononitrides, and yttrium oxide reacted with the graphite dies and were unsuitable. Tabulations of TiN and ZrN reactions with various materials indicate that relatively few practical materials are resistant to reaction at 2000° C. The efficiency of eight different graphite susceptors was tested in a 3000-cps, 25-kW induction heating unit, and it was concluded that the susceptor efficiency and length affects the heatup rate and obtainable temperature. Pressure sintering of Y_2O_3, TiC, AlN, and TiB_2 at 4000 psig formed acceptable density discs but was not successful in forming TiN, ZrN, and TiB_2 discs. Fifteen paddle-type magnesia stirrers were fabricated successfully by isostatic pressing, using a newly designed mold with neoprene pressing bags; however, several warped during firing. Two small tungsten crucibles and three plugs were sintered at 2200° C for about 10 minutes and their density values are shown in a table. G.G.

N65-25205# Value Engineering Co., Alexandria, Va.
RESEARCH AND DEVELOPMENT OF EROSION AND OXIDATION RESISTANT COATINGS Fourth Quarterly Report, 13 Dec. 1964–12 Mar. 1965
E. Goodman and R. Thompson 12 Apr. 1965 10 p
(Contract N600(19)-61804)
(Rept.-5-RD-65; AD-462144)

Chromium-coated graphite samples were subjected to several preoxidation and carburizing operations in an attempt to increase the performance of the coating. The carburizing operations included liquid bath and graphite powder carburization. Samples were evaluated in a furnace oxidation test and an oxyacetylene test. Also described are resistance heating, plasma arc, and solid-propellant rocket nozzle test samples to be tested in the near future. Author

N65-25245*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
PRE-STRAIN WELD DEVELOPMENT PROGRAM Final Report
A. C. Van Leuven 23 Apr. 1965 119 p refs
(Contract NAS8-11690)
(NASA-CR-63135; SID-65-649) CFSTI: HC $4.00/MF $0.75

A feasibility study was performed to improve the quality of 2014-T6 aluminum alloy weldments by application of mechanically or thermally induced preloads. Data were obtained on thermal flow patterns as functions of weld head location, reduction of residual stresses as functions of applied preload levels, and location, and effects of preload application on part distortions caused by welding. In mechanically applied preload weld experiments on flat panels, significant reductions were achieved in residual stresses (approximately 30%), even at nonoptimized preload levels. Substantial reductions in distortions also were achieved. Similar reductions of residual

stresses and distortions were observed in weldments performed with applied thermal (shrink-fit) preloads. A mechanics' analysis, utilizing a unit cube–parallel strip model, was developed. The analysis shows good agreement between analytically predicted and experimentally observed residual stresses, and has promise of becoming a useful tool in predicting preload magnitudes and patterns that might be applied in future production of actual parts. Author

N65-25248*# Pratt and Whitney Aircraft, Middletown, Conn.
INVESTIGATION OF CAVITATION DAMAGE OF A MECHANICAL PUMP IMPELLER IN HIGH TEMPERATURE POTASSIUM Quarterly Progress Report No. 1, 7 Dec. 1964–28 Feb. 1965
R. S. Kulp and J. V. Altieri 28 May 1965 80 p refs
(Contract NAS3-6468)
(NASA-CR-54383; CNLM-6028) CFSTI: HC $3.00/MF $0.75

A three-vaned mixed flow centrifugal impeller was water tested with an acrylic lacquer coating to determine the effects of vane tip clearance on the degree of cavitation damage which may be expected in an endurance test in 1400° F potassium. A range of NPSH values was investigated at five-vane tip clearance settings. The time required to remove the lacquer coating and size of the area removed will be used to tentatively select an NPSH condition for the potassium test. Author

N65-25255# Aeroprojects, Inc., West Chester, Pa.
ULTRASONIC WELDING PROCESS AND EQUIPMENT FOR CONSTRUCTION OF ELECTRON-TUBE MOUNTS Quarterly Progress Report, Oct. 1–Dec. 31, 1964
J. G. Thomas [1964] 16 p
(Contract DA-36-039-SC-86741)
(QPR-10; AD-614450)

During the period of operator training and preproduction evaluation with the 600-W ultrasonic welder difficulties developed with some of the special tools required for fabrication of the Type 6080WB electron tube. Some trouble was also experienced with replacements fabricated to the specifications of the original tools. Remedial action for these difficulties was initiated, and tools were redesigned for resistance to accidental damage. The 600-W welder has been returned to the laboratories for systematic checkout of the redesigned tooling, and review of the assembly sequence for the Type 6080WB electron tube. Three welding tips and one anvil assembly were fabricated and evaluated. Investigations with the tungsten–rhenium wire, as well as the molybdenum frame grid welding study, were curtailed because of the effort required with the redesign and evaluation of the tube welding tools. A 600-W welding tip for the frame grid welding study was fabricated. Author

N65-25256# Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.
PYROLYTIC COATING OF CARBON FILAMENTS Final Report, 15 May 1963–15 May 1964
K. J. Zeitsch and P. H. Higgs Wright-Patterson AFB, Ohio, AF Mater. Lab., Nov. 1964 159 p refs
(Contract AF 33(657)-11297)
(ML-TDR-64-297; AD-608764)

A continuous process was developed to coat the individual filaments of graphite yarn with pyrolytic graphite. The pyrolytic coating increased the strength-to-weight ratio of the filaments by a factor of 1.3 and acted as a sizing on the yarn to make weaving easier. Tapes woven from the coated yarn showed a load distribution factor as high as 0.9. On the basis of these studies, suggestions for extensions of this work are made. Author

N65-25314# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.
EFFECT OF THE ALUMINUM FLOW PATTERN ON THE BONDING OF ALUMINUM TO OXIDIZED ZIRCALOY-2
R. D. Watson and J. P. Lambert Apr. 1965 16 p refs
(AECL-2244) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

The bonds produced when hot aluminum is allowed to flow smoothly from an extrusion die to the oxidized surface of a heated tube of Zircaloy-2 are consistently inferior to those produced with back-extruded flow. The difference is believed due to the reduction in, or elimination of, the oxide layer on the aluminum that comes in contact with the surface of the Zircaloy-2. Author

N65-25316# College of Aeronautics, Cranfield (England). Dept. of Materials
THE INFLUENCE OF THE STATIC AND DYNAMIC CHARACTERISTICS OF POWER SOURCES ON THE BEHAVIOUR OF SHORT CIRCUITING CO_2 SHIELDED WELDING ARCS
B. S. Pierozeck and L. M. Gourd Feb. 1965 25 p refs
(CoA-Note-Mat-6)

Oscillographically, the influence of variable slope and variable inductance on the characteristics of short circuiting CO_2 shielded metal arcs, and the variables affecting the optimum welding conditions were determined. It was established that this optimum is usually below the maximum of the frequency–voltage curve. Both the slope of the power source characteristic and the value of the inductance in the circuit have similar qualitative effects on the stability of the short circuiting arc. Nevertheless, control of the dynamic response by varying inductance was found to be more flexible and effective. For this reason, it is suggested that separate control of the static characteristic and dynamic response is not necessary to obtain optimum conditions. Thus the correctly designed power source for short circuiting CO_2 shielded arc welding should have constant slope of the static characteristic and continuous control of the dynamic response. Author

N65-25318# Los Alamos Scientific Lab., N. Mex.
THE FABRICATION OF LEAD-BORON CARBIDE COMPONENTS FOR KIWI NEUTRON-GAMMA COLLIMATOR
Haskell Sheinberg 4 Nov. 1964 59 p
(Contract W-7405-ENG-36)
(LA-3139) CFSTI: $3.00

The details are described of operations required for the fabrication of lead, 2.0 wt% boron carbide (B_4C) components for the Kiwi neutron-gamma collimator by powder metallurgy techniques. This unusual combination of materials is not reported in the literature. The process employed involved blending high purity commercial powders and warm pressing the blended powers in graphite dies. Size of pressed components varied in diameter from 4.54 to 26.08 in. and in thickness from 1.06 to 8.68 in. The weight varied from 16 to 403 lb. Chemical analysis of blended powders and pressed parts, results of radiographic inspection of typical pressed components, and temperature and pressure profiles for the warm pressings are included. Author

N65-25346*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ACOUSTIC TECHNIQUES FOR THE NONDESTRUCTIVE EVALUATION OF ADHESIVELY BONDED COMPOSITE MATERIALS
W. N. Clotfelter 17 Mar. 1965 47 p refs
(NASA-TM-X-53219) CFSTI: HC $2.00/MF $0.50

The extensive usage of composite materials in the Saturn vehicle has required considerable effort in the development of nondestructive inspection methods to evaluate the mechanical integrity of these materials. This report describes through-transmission and single-side acoustic methods applicable to the quality verification of composite panels. Some of the techniques discussed are "off the shelf." Others are believed to be unique. All of these inspection methods are discussed and illustrated to show their applicability to the quality verification of certain types of composite structure used in the Saturn. An attempt has been made to relate selected techniques to the acoustic characteristics of the materials used. Author

N65-25380# Crystalonics, Inc., Cambridge, Mass.
PRODUCTION ENGINEERING MEASURE TO IMPROVE PRODUCTION TECHNIQUES AND TO INSURE THE RELIABILITY OF THE C600 SERIES FIELD EFFECT TRANSISTORS Quarterly Report, 1 Oct.–31 Dec. 1964
John R. Williams [1964] 24 p
(Contract DA-36-039-AMC-01483(E))
(QR-6; AD-613068)

Progress is reported on a program to improve the reliability of field effect transistors by improving manufacturing techniques. The operation and controls for a production run are described and include slice preparation, chip inspection, mounting, bonding, inspection and trimming, electrical and visual inspection, bake and seal, stabilization bake, and environmental and electrical test. An IBM data collection system was programed for the 2000-hour life testing program. R.N.A.

N65-25381# Aeroprojects, Inc., West Chester, Pa.
ULTRASONIC WELDING PROCESS AND EQUIPMENT FOR CONSTRUCTION OF ELECTRON-TUBE MOUNTS Quarterly Progress Report, Jul. 1–Sep. 30, 1964
J. G. Thomas 1964 20 p
(Contract DA-36-039-SC-86741)
(QPR-9; AD-612600)

All of the connections in the modified Type 6080WB electron tube were accomplished by ultrasonic welding with a standard 600-W welding machine, special tips, and anvil tooling. Welding investigations with molybdenum wire wound frame grids were limited to tooling design studies. Welding studies which involve ultrasonic bonding of 0.003-inch diameter tungsten–3 rhenium wires to molybdenum, tungsten, and nickel in 0.060-inch flat sheet are progressing satisfactorily, and final samples for shock and vibration testing will be prepared after minor welder tooling modifications such as grooving of tip and substitution of tip material from tool steel to Udimet 700 are completed. Author

N65-25394# Mechanical Technology, Inc., Latham, N. Y.
EXPERIMENTAL INVESTIGATION OF A STEAM LUBRICATED JOURNAL BEARING Summary Report
J. S. Meacher 1 Feb. 1965 51 p refs
(Contract Nonr-3731(00) FBM)
(MTI-65TR6; AD-612899)

An externally pressurized, orifice-compensated journal bearing was tested using both nitrogen and steam as lubricant gas. Nonrotating tests were performed to determine load-deflection characteristics, stiffness, and flow requirement. Performance with superheated steam, and shaft and bearing temperatures equal to that of the inlet steam, was practically identical to the performance with nitrogen. Instability similar to pneumatic hammer was observed when shaft temperature was more than 10° F below the inlet steam saturation temperature, using either saturated or wet steam. A minor instability of a different nature occurred when test conditions favored the condensation or accumulation of water droplets in the bearing supply manifold. The bearing was completely unstable when shaft temperatures were more than 25° F below the inlet saturation temperature. The use of wet steam, saturated steam, or slightly superheated steam, while maintaining shaft temperature 10°F below, at, or 10°F above the inlet saturation temperature resulted in negligible differences in stiffness and load-deflection curves. Some evidence was observed that increased rates of evaporation within the bearing clearance produced slight increases in bearing stiffness. Author

N65-25397# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHODS OF TESTING COMPONENTS AND MATERIALS OF MACHINES AND INSTRUMENTS Selected Articles
28 Jan. 1965 34 p refs Transl. into ENGLISH from a Soviet publ.
(FTD-TT-64-247; AD-612763)

CONTENTS:

1. QUESTION ABOUT SELECTION OF MATERIALS FOR OPEN-TOOTHED TRANSMISSIONS WORKING WITHOUT LUBRICANT IN AGGRESSIVE MEDIA T. T. Belousova and S. F. Fonarev p 1–13 refs

2. EXPERIMENTAL INVESTIGATION OF ANTIFRICTION PROPERTIES OF CARBON AND GRAPHITE BASE MATERIALS WORKING IN CONDITIONS OF DRY FRICTION S. F. Fonarev, A. A. Kul'bakh, and V. A. Dzhonson p 14–20

3. INVESTIGATION OF ANTIFRICTION PROPERTIES OF MATERIALS BASED ON GRAPHITE OF BRANDS AG1500-B83 AND AG1500-CU, WORKING IN CONDITIONS OF DRY FRICTION S. F. Fonarev, A. A. Kul'bakh, and V. A. Dzhonson p 21–31 ref

N65-25403*# Honeywell, Minneapolis, Minn. Aeronautical Div.
DEVELOPMENT PROGRAM FOR A HIGH FREQUENCY PUMP AND HYDROSTATIC SUSPENSION FOR THE GG159C GYRO Final Report
R. F. Anderson Apr. 1965 56 p refs Prepared for JPL *Its* Aero Rept.-1727-FRL)
(Contracts NAS7-100; JPL-950604)
(NASA-CR-63182) CFSTI: HC $3.00/MF $0.50

The development of a high-frequency pump gimbal suspension system for the gas spin bearing gyro is discussed. A suspension system which provides a 15-g gimbal support capability, maintains feasible gimbal clearances, and minimizes the damping was scaled. A rotary pump concept to provide the required output was found feasible but had a high power requirement of ~2.5 watts. A piezoelectric pump consisting of a dither plate and a stationary plate, each having an orifice oriented in series to provide a rectified fluid flow large enough to support the proposed suspension system, was developed and tested. The pump operates at 100 volts and 400-cps excitation frequency. Best results were obtained when the piezoplate assembly and rectifier plates were mounted with 0.070 cross-sectional diameter × 1.25 o.d. major diameter O-rings between the plates and on each side of the complete assembly. G.G.

N65-25405*# Honeywell, Minneapolis, Minn. Aeronautical Div.
STUDY PROGRAM TO DETERMINE THE ACCELERATION ENVIRONMENT CAPABILITY OF THE GG159C GAS-BEARING SPINMOTOR Final Report
G. J. Erickson 10 Jul. 1964 54 p Prepared for JPL *Its* Aero Rept.-1727-FRI
(Contracts NAS7-100; JPL-950604)
(NASA-CR-63180) CFSTI: HC $3.00/MF $0.50

Four gas-bearing spinmotors, a test fixture, and a dummy gyro were built and tested to determine the g environment under which the gas-bearing spinmotor (GBSM) could reliably operate. The application of an improved thrust bearing enabled the GBSM to withstand shock of 200 g's and random vibrations of 25 g_{rms}. Testing of a dummy gyro containing three orthogonally mounted accelerometers instead of a spin motor inside the gimbal resulted in the g transmissibility of the GBSM gyrostructure from the gyro outer flange to the internal gimbal motor mounts. The transmissibility was independent of the environmental level. Two GBSMs were exposed to a high g environment of 1.5 millisecond shock. One GBSM with 13 bearing contacts on journal and thrust bearings showed hard starting problems for a short time, but the other GBSM exposed to one shock contact on each bearing, started and stopped reliably. The nonoperating GBSMs are currently on life test exposure to shock and random vibration. G.G.

N65-25440# General Dynamics/Astronautics, San Diego, Calif. Reliability and Maintainability Dept.
SPACE LAUNCH VEHICLE RELIABILITY IMPROVEMENT PROGRAM Progress Report No. 16, 25 Jan.–25 Feb. 1964
1 Mar. 1964 66 p
(Contracts AF 04(694)-240; AF 04(695)-379; AF 04(695)-458; AF 04(695)-514)
(BHC-63-001-9; AD-461019)

Subjects included are *Design Assurance; Reliability Operational Model Program; Reliability Assessment; Human Factors and Maintainability; Reliability Parts and Material Requirements; Reliability Testing;* and *Failure History and Failure Analysis Summary.* E.E.B.

N65-25464# Air Products and Chemicals, Inc., Allentown, Pa. Research and Development Dept.
ENERGY DEPOT CRYOGENIC FUEL STORAGE AND DISTRIBUTION SYSTEM. PHASE I: CONCEPTUAL DESIGN STUDY Quarterly Progress Report No. 3, Oct.–Dec. 1963
R. G. Clark, A. Karalis, H. Rowles, and P. D. Stelts Jan. 1964 63 p refs
(Contract AT(30-1)-3129)
(APCI-541103) (Declassified)

Welding procedures were established and physical testing of weldments is near completion for the series of high strength steel and aluminum alloys considered promising for lightweight liquid hydrogen vessels. The test vessel fabricated and development testing is near completion. Design of the lightweight vessel is completed. Conceptual design of the integrated fuel storage and distribution system was established. Author

N65-25475# United Kingdom Atomic Energy Authority, Risley (England).
SAFETY IN THE USE OF GAS CYLINDERS
E. W. F. Whalley 1965 20 p refs
(AHSB(S)-R-84) HMSO: 4s 6d

This report is intended primarily to provide operators with model safeguards for the storage, handling, use, and transport of gas cylinders. Author

N65-25522# Martin Co., Baltimore, Md. Nuclear Div.
SNAP 19 PROGRAM. EJECT MECHANISM COLD WELDING EVALUATION
S. Podlaseck May 1965 12 p refs
(Contract AT(30-1)-3169)
(MND-3169-66)

The potential cold welding at metal contacting surfaces of the SNAP-19 eject mechanism and the use of lubrication in eliminating this problem are discussed. The prime areas of concern are the backup nut piston, assembly interface, the piston cylinder interface, the guide pin-guide pin slot interface, and the release bolt-upper spring interface. A molybdenum disulfide solid film lubricant, its application techniques, expected lifetime, and frictional characteristics in a space environment are examined. Weight losses through sublimation and dissociation are immeasurably small for the expected lifetime at temperatures below 200° F. The lubricant's behavior is more desirable and more predictable in a vacuum than under normal atmospheric conditions. A dry film coating applied to the piston assembly and upper spring assembly will eliminate all interfacial contact problems in the eject assembly. R.N.A.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N65-24550 Joint Publications Research Service, Washington, D. C.
THE DIVERGENCE OF RADIATION IN A HELIUM–NEON LASER
V. I. Makhorin and Ye. D. Protsenko *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 256–260 refs (See N65-24525 14-07) CFSTI: $7.00

An analysis of output radiation divergence in helium–neon lasers with spherical reflectors is presented. Results of measurements of the lower modes and modes of higher orders confirmed the fact that in resonators with spherical reflectors and small diffraction losses, the quality factor can be increased by increasing the distance between the mirrors without changing the divergence. Also considered was divergence of single and two-beam patterns. It is concluded that divergence of each mode in a two-beam pattern is the same as that of similar modes generated under one-beam conditions. S.C.W.

N65-24689# Joint Publications Research Service, Washington, D. C.
BULGARIAN LASERS
K. Kotsev 25 May 1965 5 p Transl. into ENGLISH from Otechestven Front (Sofia), 24 Mar. 1965 p 1–2
(JPRS-30232; TT-65-31073) CFSTI: $1.00

A brief history on the development of lasers is given and the principle of forced radiation of energy through excited atoms is examined. Their use for piercing solid materials in machine building, in microelectronics, and as surgical tools in eye surgery, microbiology, etc., are discussed. Application of continuously operating gas lasers as radio transmitters, in communications transportation, and for measurements, and of small semiconductor lasers in physical research, electronic computers, is also discussed. Future aspects of laser applications in photon rockets, charting a topographic moon map, cybernetics, and in a laser rifle with a capacity of 10000 shots which may blind at a distance of 1500 meters, are projected. G.G.

N65-24722*# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
RECEIVER TECHNIQUES AND DETECTORS FOR USE AT MILLIMETER AND SUBMILLIMETER WAVELENGTHS Semiannual Report, 1 Sep. 1964–28 Feb. 1965
28 Feb. 1965 12 p refs *Its* Rept.-1093-26
(Grant NsG-74-60)
(NASA-CR-62881) CFSTI: HC $1.00/MF $0.50

A new theoretical analysis of the developed radiometer from the integral equation point of view was performed, and a complete set of experimental data and its analysis in both the periodic and the aperiodic modes was obtained. The results indicate good performance. The construction of a high-temperature source (2500° K), the design of an optical system for the 50-foot absorption cell, and the construction of vacuum chambers for the radiometer have been completed to enable measurements of water-vapor absorption in a laboratory environment. The construction of a 5-meter submillimeter helium–neon laser is almost completed. The merits of sky observations in the millimeter–submillimeter wavelength regions from 50-microns to 1-mm wavelength are discussed. G.G.

N65-24836# Army Missile Command, Huntsville, Ala.
REDSTONE SCIENTIFIC INFORMATION CENTER LASERS
Gus J. Caras 30 Apr. 1964 41 p refs
(RSIC-195; AD-462245)

This state-of-the-art survey consists of a technical summary and a bibliography. The bibliography, which consists of 125 references and covers the period of 1 January 1963 to 31 December 1963, deals mostly with the subject of laser pumping. The summary reviews other topics of laser technology, and includes a description of the various types of lasers and their potential applications. Author

N65-24968# American Meteorological Society, Boston, Mass.
RELAXATION OSCILLATIONS IN THE EMISSION OF RUBY LASERS UNDER VARIOUS OPERATIONAL CONDITIONS [RELAXATIONSCHWINGUNGEN IN DER EMISSION OPTISCHER RUBIN-MASER UNTER VERSCHIEDENEN ARBEITSBEDINGUNGEN]
Karl Gürs Bedford, Mass., AFCRL, Jun. 1964 16 p refs Transl. into ENGLISH from Z. Naturforsch. (Tubingen), v. 18a, no. 4, 1963 p 510–515
(Contract AF 19(628)-3880)
(T-G-215; AD-458887)

The variations of the emission of ruby lasers with changes in resonator design and crystal temperature were investigated experimentally and theoretically. A survey of the feasible emission behavior under different conditions is presented. For example, ruby, like certain other substances, can produce an emission which does not consist of pulses but is oscillation-free. Author

N65-25016 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
THEORY OF LASER GIANT PULSING BY A SATURABLE ABSORBER
A. Szabo and R. A. Stein (Alberta Univ.) *In its* Bull. of the Radio and Elec. Eng. Div., V. 14, No. 3, Jul.–Sep. 1964 [1964] p 6–11 refs (See N65-25013 14-07)

The development of a theory of laser giant pulsing by a saturable absorber, based on a generalization of an earlier theory which considers using a saturable absorber inside the laser cavity as a fast optical switch, is reported. In the proposed theory, loss terms are added to the cavity and population rate equations which account for the presence of the saturable absorber in the cavity. These terms are shown to provide self giant pulses, provided that the ratio of laser to absorber cross sections is sufficiently large. The main assumptions of the theory are that the absorber centers are uniformly distributed in the laser cavity and that processes such as relaxation and pumping effects, which are slow as compared with the time scale of the giant pulse, are neglected. A comparison of the theory with giant pulsing experiments showed good agreement for pulse width; however, predicted peak power output was larger than the experimental value. Several calculated characteristics of a ruby giant pulse laser using a saturable absorber for two operating temperatures are included. S.C.W.

N65-25126 Lockheed Missiles and Space Co., Palo Alto, Calif. Electronic Sciences Lab.
COHERENT LIGHT GENERATION
W. Culshaw, C. H. Bazzill, J. A. Dahlquist, R. A. Early, L. B. Fowles et al *In its* Progr. Rept., Jan.–Mar. 1965 [1965] 14 p refs (See N65-25125 14-34)

Progress on planar-type gas, confocal-type, and solid state lasers is reported. A short He–Ne laser, with a reflector spacing of 21.25 cm and operating at 1.153 microns, was constructed. This reflector spacing gives a frequency separation of 706 Mc/sec between axial modes and assures single-mode operation under most conditions. The laser tube has a bore of 3 mm and a discharge of 11.5 cm long, excited by an rf-source at 52.5 Mc/sec. A solenoid of 3.2-cm diameter and 14.6 cm long was placed around the laser tube for applying axial magnetic fields in the study of coherence effects due to small axial magnetic fields. Also, a pulsed gas discharge laser was made and operated simultaneously on six lines of the Argon II spectrum. The tube was 130 cm long with a bore of 3 cm and Brewster windows. The cavity length was 140 cm and the reflectors have optimum reflectivity at 4500 and 5300 Å. Further, a system for the study of magnetic fields in continuously operating solid state lasers was assembled. This laser uses N_2 or supercooled liquid O_2 as a coolant and a 1000-W tungsten lamp as an optical pumping source. An yttrium–aluminum–garnet laser rod doped with Nd^{3+} was also operated at room temperature. E.E.B.

N65-25191# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
PROPAGATION OF INTENSE LASER RADIATION Final Engineering Report, 1 Jan. 1963–31 Dec. 1964
15 Apr. 1965 30 p refs *Its* Rept.-1579-20
(Contract AF 33(657)-10824)
(AFAL-TR-65-83; AD-461627)

Research directed towards investigating factors limiting the transfer of laser radiation through real media is summarized. Laser-induced gaseous breakdown is discussed, and some measurements on the frequency dependence of this phenomenon are given. Parametric interactions of radiation and matter are described, and a new type of Brillouin scattering is observed. The coherence characteristics of spiking multimode lasers are discussed, and the influence of the measuring techniques on the measured coherence properties is examined. Atmospheric resonance absorption is reviewed, and results at specific laser frequencies are given. Related effort in laboratory source and instrumentation development is described. Author

N65-25386# Corning Glass Works, N. Y.
GLASS LASER RESEARCH Semiannual Technical Report, Jul.–Dec. 1964

R. D. Maurer, N. F. Borrelli, M. E. Vance, and G. E. Stong
30 Jan. 1965 99 p refs
(Contract Nonr-3833(00))
(AD-612964)

A series of investigations aimed at the more efficient utilization of neodymium glass lasers are reported. Deterioration under intense light was discussed, with damage on the cylindrical surface shown to be due to scratches and imbedded particles. This was eliminated by chemical treatment of the surface. The mechanism of solarization is delineated and the problem eliminated by pump light filtering with a minimal 15-percent loss in output. Improvement of performance by varying external conditions is presented. The efficiency of various pump bands is given in detail for matching light sources. Output is further maximized by varying the cavity coupling. From these output coupling data the first dynamic internal loss values for a near perfect static medium are reported. Processes occurring within the laser itself are considered. A detailed investigation to find an accurate value of the gain cross section (without assuming degeneracies) shows that a straightforward spectroscopic study can only yield this quantity within a factor of two. Data are given on the time-resolved distortion of a pumped rod, to determine the magnitude of this problem in preventing diffraction limited operation.

Author

N65-25532# Perkin-Elmer Corp., Norwalk, Conn. Electro-Optical Div.
TUNABLE COHERENT LIGHT SOURCE Quarterly Progress Report, 1 May–31 Jul. 1964
N. I. Adams [1964] 14 p
(Contract Nonr-4572(00))
(PE-TR-7776; AD-613968)

Work on the development of a tunable coherent light source based on nonlinear optical effects continued with improvements of the 1.1523μ helium–neon laser, and incorporation of a gas recirculation tube in the pulsed argon laser. A piece of magneto-optic glass has been prepared for placement into a laser resonator with negative feedback to calculate the resonator's sensitivity. A quantitative theory for optical parametric effects of Raman lasers was developed, and calculations of losses for plane-parallel slab windows, and special prism windows bounding the contaminated material were performed.

G.G.

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N65-24428# Mechanical Properties Data Center, Suttons Bay, Mich.
TENSILE FRACTURE TOUGHNESS Inventory Report No. 623
Mar. 1965 6 p
(AD-613567)

Tensile fracture toughness data are tabulated. Values indicate the quantity of results (tested specimens) for each combination of alloy, temperature range, and toughness index available. In addition to the measured property values, information on test environment, material conditions, material form, and test procedure is stored to supplement and define the test results. Formulas employed to calculate indices are also stored with data when reported.

Author

N65-24432# Pressure Technology Corp. of America, Woodbridge, N. J.
AN INVESTIGATION OF Be AND W ALTERED BY HIGH-PRESSURE DEFORMATION Engineering Progress Report No. 4, Jul. 7–Sep. 7, 1964
Alfred Bobrowsky [1964] 15 p
(Contract NOw-64-0180-c)
(AD-614086)

Bending tests were conducted on hot-pressed beryllium (Be) sheet. In general, higher pressures increased the permissible bend angle for each sheet. Tensile tests under pressure were made on cast and hot-extruded Be. Tensile tests under pressure were also run on several types of polycrystalline tungsten (W), and on single crystals of W.

Author

N65-24433# Pressure Technology Corp. of America, Woodbridge, N. J.
AN INVESTIGATION OF Be AND W ALTERED BY HIGH-PRESSURE DEFORMATION Engineering Progress Report No. 5, Sep. 7–Nov. 7, 1964
Alfred Bobrowsky [1964] 11 p
(Contract NOw-64-0180-c)
(AD-613969)

Fluid-to-fluid extrusion of hot-pressed beryllium (Be) was continued. Reductions up to 40% were made. Tensile tests under pressure of hot-pressed Be were performed. A rebinder effect appears to be present. Working the Be enhances its strength considerably. Bending tests under pressure were made on tungsten (W) sheet. In general, increasing pressure increases permissible bend angle.

Author

N65-24444# United States Steel Corp., Monroeville, Pa.
THE KINETICS AND MECHANISMS OF THE STRENGTHENING OF MARAGING STEELS Summary Report, 1 Apr. 1963–30 Sep. 1964
B. G. Reisdorf and A. J. Baker Wright-Patterson AFB, Ohio, AF Mater. Lab., Jan. 1965 125 p refs
(Contract AF 33(657)-11149)
(AFML-TR-64-390; AD-610686)

The fine-scale microstructures of the 18Ni(250) and 18Ni(300) grades of maraging steel were examined using electron microscopy of thin foils and extraction replicas in conjunction with electron-diffraction and electron-probe analyses of particles extracted from these steels. The microstructure of both steels in the annealed condition consists of small, equiaxed martensite grains containing a high dislocation density but few microtwins. The main source of the strengthening that occurs in these steels during aging is the precipitation of extremely fine particles of intermetallic compounds. The size, shape, and distribution of these particles were determined for a variety of aging conditions. The major precipitate, Ni_3Mo, appears to nucleate on dislocations, and during the early stages of aging it occurs in the form of ribbons or rods. A second precipitate, which nucleates homogeneously, appears as small spheres in the early stage of aging, but indirect evidence suggests that it is Ni_3Ti. Upon continued aging, both types of precipitates assume the form of platelets or discs. Although the presence of cobalt in these steels provides a strong contribution to their strength in the aged condition, the mechanism whereby this is accomplished is not known. This

mechanism does not appear to be order hardening or the precipitation of cobalt-rich particles. Author

N65-24445# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
STRESS-CORROSION CRACKING OF ALUMINUM ALLOYS
James D. Jackson and Walter K. Boyd 15 Feb. 1965 19 p refs (Contract AF 33(615)-1121)
(DMIC-MEMO-202; AD-613957)

Aluminum alloys most often associated with stress-corrosion cracking in actual service are 2014, 2024, 2219, 7075, 7079, and 7178 alloys, and cast alloys of Ternalloy 7, 40E, 195, and 220 compositions. The tensile stresses necessary to initiate stress-corrosion cracking may be either applied (as through static loads, press fits, or fasteners), or residual (such as from heat treatment or machining). The prevention of failure requires a basic knowledge of the phenomenon and of the relative resistance of the various alloys, and of the effect of grain structure on cracking susceptibility. Application of this knowledge and use of good practices in heat treatment, working, forming, machining, and design can reduce the incidence of stress corrosion. The application of compressive stresses such as by shot peening or the use of coatings offers an effective means of minimizing or at least delaying stress-corrosion cracking. Laboratory investigations of stress-corrosion cracking often involve C-ring or tensile specimens exposed by alternate immersion in 3 1/2% NaCl solution. Author

N65-24450# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics
ON GENERAL REPRESENTATION OF A DENSITY FUNCTION
M. Shinozuka and A. Nishimura Feb. 1965 23 p refs (Contract Nonr-266(91))
(TR-14; AD-613713)

To establish analytical forms of density functions of the resistance of structures and of the applied load from samples of finite size for computing the failure probability in the structural reliability analysis, series expansion methods associated with the gamma distribution and of the asymptotic expansion are introduced. Two known methods, Gram–Charlier's series of type-A and type-C, are reviewed with numerical examples. On the basis of these examples, it may be concluded that all the methods, except the asymptotic expansion, produce desirable results in the central portion of the distribution and that the simultaneous use of the Gram–Charlier series of type-A and the asymptotic expansion will in many cases cover the entire domain of the variable. Author

N65-24463# Joint Publications Research Service, Washington, D. C.
LIQUID METALS IN METALLURGY
4 May 1965 34 p refs Transl. into ENGLISH from the publ. Zhidkiye Metally—Sbornik Statey (Moscow), 1963 p 292–306, 313–325
(JPRS-29916; TT-65-30905) CFSTI: $2.00

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3. CENTRIFUGAL LABORATORY PUMPS FOR TRANSFERRING LIQUID METALS A. A. Andreyevskiy and D. M. Kalachev p 18–24 refs (See N65-24466 14-15)

4. MERCURY GEAR PUMP L. I. Gel'man, A. N. Gasilovskiy, and I. Z. Kopp p 25–31 refs (See N65-24467 14-15)

N65-24464 Joint Publications Research Service, Washington, D. C.
INFLUENCE OF LIQUID SODIUM ON THE LONG-TIME STRENGTH OF STRUCTURAL MATERIALS
G. P. Dykova and V. I. Nikitin *In its* Liquid Metals in Met. 4 May 1965 p 1–9 refs (See N65-24463 14-17) CFSTI: $2.00

The long-time strength in liquid sodium and in air is determined for steel EI-851 at 700° for alloy EI-869 at 750°, and for alloy EI-437B at 800° The absence of influence of the liquid metal on the long-time strength and creep is demonstrated for steel EI-851 and alloy EI-869. Alloy EI-437B displayed a lowering of long-time strength and plasticity and increased creep rate in all periods in the liquid-metal medium. It was determined that the dependency of the time to destruction and creep rate on the applied stress for alloy EI-437B in a liquid metal is exponential, as is the case in air. It was shown that the influence of the liquid sodium on the long-time strength and creep of alloy EI-437B at 800° is determined by the adsorptive properties of the medium. The adsorptive effect of the liquid metal which was brought out confirmed the mechanism of the migration of dislocations under conditions of creep. Author

N65-24465 Joint Publications Research Service, Washington, D. C.
INFLUENCE OF LIQUID SODIUM ON RELAXATION OF STRESSES IN STEEL
V. I. Nikitin *In its* Liquid Metals in Met. 4 May 1965 p 10–17 refs (See N65-24463 14-17) CFSTI: $2.00

The relaxation stability of materials in a medium of liquid metal is investigated using a chamber consisting of two cylinders with internal 5 and external 4 headers welded together. From curves obtained from the experimental data the following basic laws of the influence of liquid sodium on the relaxation of stresses for the steels investigated were established: at all initial stresses the liquid metal accelerates the process of relaxation; the influence of the medium is most pronounced in the first stages of relaxation; and the influence of the medium is increased with increasing initial stress. It is observed that the difference between the speeds of deformation (or rate of the decrease of stress during relaxation) in a surface active medium and in air is maximum at the beginning of creep (relaxation) and decreases gradually in accordance with the decreasing role of the slip process. N.E.A.

N65-24570*# Hydronautics, Inc., Laurel, Md.
CAVITATION DAMAGE IN LIQUID METALS Technical Progress Report, 1 Jan.–31 Mar. 1965
A. Thiruvengadam, H. S. Preiser, and S. L. Rudy 28 Apr. 1965 19 p refs
(Contract NAS3-4172)
(NASA-CR-54391; TPR-467-2) CFSTI: HC $1.00/MF $0.50

The effect of temperature on the rate of cavitation damage of 316 stainless steel in pure liquid sodium at temperatures up to 1500° F was determined. The intensity of cavitation damage was estimated for each temperature, using the rate of damage obtained from these experiments and published strain energy values. The intensity is found to be very much less at higher temperatures. The intensity of damage at 1000° F

is about a tenth of the intensity at 400° F; at 1500° F the intensity of damage is about a thousandth of that at 400° F. Author

N65-24631# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
A BIBLIOGRAPHY ON TRACER DIFFUSION IN METALS. PART I: SELF DIFFUSION IN PURE METALS
John Askill, comp. May 1965 28 p refs
(Contract W-7405-ENG-26)
(ORNL-3795)

Frequency factors and activation energies for self-diffusion in pure metals were compiled from the literature reported between 1938 and 1964. An author's index is also included. Author

N65-24688# Joint Publications Research Service, Washington, D. C.
EFFECT OF VACUUM DEGASSING ON CASTING PROPERTIES OF ALLOYS
Yu. A. Nekhendzi 24 May 1965 38 p refs Transl. into ENGLISH from the book "Fiziko-Khimicheskiye Osnovy Metallurgicheskikh Protsessov" Moscow, Metallurgizdat, 1964 p 266–297
(JPRS-30212; TT-65-31061) CFSTI: $2.00

The effect of different vacuum degassing conditions on duration of hardening, fluidity, volume of shrinkage blowholes and density, linear contraction, crystallization under conditions of various cooling rates, content of gases and nonmetallic inclusions, and crack-resistance of several alloys was investigated. Ordinary alloys and those with special physical and chemical properties were selected for the study—those having a wide and narrow hardening range, those forming gum, and those with easily vaporized elements. These chief groups encompassed cast iron of the usual varieties, and those with spheroidized graphite; steel with different carbon content, and steel high alloyed with boron; heat-resistant alloys based on iron and nickel, including those alloyed not only with titanium and aluminum but also with nitrogen; pure and technical grade aluminum, its alloys containing silicon, zinc, copper, and magnesium; and alloys of copper with silicon. Author

N65-24702# Manlabs, Inc., Cambridge, Mass.
EXTENSION OF THE γ-LOOP IN THE IRON–SILICON SYSTEM BY HIGH PRESSURE
Martin Schatz and Larry Kaufman 1 Jan. 1964 18 p refs
(Contract Nonr-2600(00))
(TR-7; AD-426182)

The effect of pressure on the extension of the γ-loop in the iron–silicon system was determined by means of metallographic studies, and hardness measurements were performed on a series of high purity iron–silicon alloys containing 7.5, 11.0, and 13.9 at.% silicon, respectively. These measurements, performed at 42 kilobars and temperatures up to 1200° C, indicate that the γ-loop is expanded to about 10 at.% silicon at 42 kilobars as opposed to a maximum extension of 4 at.% silicon at 1 atmosphere. Comparison of the experimental results with thermodynamic predictions of the pressure shifts yields satisfactory results. Author

N65-24703# Dow Chemical Co., Denver, Colo. Rocky Flats Div.
A REVIEW OF METAL CLEANING BY ION BOMBARDMENT
J. R. Mullaly 2 Dec. 1964 43 p refs
(Contract AT(29-1)-1106)
(RFP-433)

Presented are results of a literature survey to determine inherent problems in the technique of cleaning metal surfaces by ion bombardment. Utilized was research focusing on the determination of the number of atoms removed per ion striking the surface and the study of surface effects. Results on bombardment of nonmetals are included only where the same effects may be expected for metals. Included is a discussion of phenomena occurring at a surface undergoing ion bombardment emphasizing sputtering effects and methods for determining deposition; parameters affecting sputtering and the production of a clean surface; methods used to demonstrate the cleanliness of ion bombarded surfaces, such as low energy electron diffraction; and a discussion of systems which have been used to produce atomically clean surfaces. Also included is a review of the glow discharge, negative probe, ion beam, bombardment schemes; and an ideal cleaning experiment. S.C.W.

N65-24714# Royal Inst. of Tech., Stockholm (Sweden).
LOW CYCLE STRAIN FATIGUE—A LITERATURE REVIEW COVERING NATURAL PHENOMENA AND THEORY OF RESULTS ON MATERIAL FOR SUPERHEAT FUEL CLADDING [TOJNINGSUTMATTNING, EN LITTERATURGRANSKNING AVSEENDE FENOMENETS NATUR OCH TEORI SAMT TILLAMPNING PA MATERIAL FOR OVERHETTARKAPSLING]
Torsten Ericsson 1964 109 p refs In SWEDISH; ENGLISH summary
(Publ-147)

A literature study on results from isothermal low cycle strain fatigue experiments using austenitic stainless steel and nickel alloys, as well as other materials, was conducted. Low cycle fatigue after less than 10^5 cycles is expressed in the equation:

$$\Delta e_p N_F^m = C$$

where N_F is the fracture value and the plastic strain range is Δe_p. The constant C is mostly a little higher than half the fracture ductility e_F of a simple tensile test. Tests performed with constant stress and constant strain amplitude contribute differently to the cycles to fracture. Grain size and the orientation of a specimen in relation to the rolling direction had little influence on the fracture value. Neutron irradiation on stainless steel simultaneously with cycling diminishes the fracture value. A compilation and comparison of low cycle strain fatigue tests of various materials are presented in tables. G.G.

N65-24728# California Univ., Livermore. Lawrence Radiation Lab.
A STRESS-CRACKING STUDY OF A GAMMA EXTRUDED U-8 w/o Mo-0.50 w/o Ti ALLOY
C. A. W. Peterson 15 Apr. 1965 12 p refs
(Contract W-7405-ENG-48)
(UCRL-14132) CFSTI: $1.00

The U–8 wt% Mo–0.50 wt% Ti alloy is subject to stress cracking in air during static or low strain-rate loading while in the metastable gamma phase condition. Average critical stress is higher than that observed for the U–Mo binary alloy, but too low to use the alloy under stress except in oxygen-free environments. However, if the alloy is transformed from the gamma phase to the alpha plus gamma condition, the stress-cracking brittleness disappears. Homogenization of the duplex grain structure of this gamma-extruded alloy could be achieved only by drastic cold working followed by an anneal at gamma phase temperatures. Author

N65-24739# Massachusetts Inst. of Tech., Cambridge.
RESEARCH IN MATERIALS SCIENCE AND ENGINEERING Annual Report No. 3, 1963–1964
E. W. Schafer, R. A. Smith et al Apr. 1964 335 p refs

Research at MIT in the field of materials—their preparation, structure, and properties—is reported. The presentations are divided into a number of sections mainly based on the subject matter as follows: (1) chemical and solid state physics; (2) electronics, magnetic and optical properties of materials, and material science; (3) metallurgy and material science; and (4) materials engineering. N.E.A.

N65-24743# Joint Publications Research Service, Washington, D. C.
PROPERTIES OF STEEL 15KH5MF WELDED JOINTS PRODUCED BY ELECTROSLAG WELDING
F. G. Gonserovskiy *In its* Electroslag Welding 24 May 1965 p 55–72 refs (See N65-24740 14-15) CFSTI: $3.00

Results of an analysis of the mechanical properties, chemical composition, and microstructure of automatic electroslag welded joints and seams of middle alloyed steels, such as chromium–molybdenum–vanadium and chromium–molybdenum, are presented. Included are data on strength indices in the seam and heat affected zones; the effects of heat treatment, tempering, and normalization; and the feasibility of using the electroslag welding technique in the manufacture of steel structures. S.C.W.

N65-24753# General Dynamics/Convair, San Diego, Calif.
MECHANICAL PROPERTIES OF MATERIALS, ROT STUDY (RE-USABLE ORBITAL TRANSPORT)
R. S. Gill 19 Nov. 1964 65 p refs
(GD/A-DDG-64-030)

The mechanical properties of materials being considered in a preliminary study on the Re-usable Orbital Transport project are presented. The properties are classified into four categories in descending order of their reliability as final design allowables. Data sources for tensile and creep-stress rupture properties, and specifications for the materials presented are tabulated. Curves representing temperature effects on tension yield and ultimate strength, creep deformation and rupture, and comparisons of tension ultimate, tension yield, and stress-rupture data are presented. R.N.A.

N65-24775*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPLORATORY STUDY OF BEND DUCTILITY OF SELECTED REFRACTORY METAL WELDMENTS
John H. Sinclair Washington, NASA, Jun. 1965 29 p refs (NASA-TN-D-2865) CFSTI: HC $2.00/MF $0.50

Preliminary tests were made to determine the influence of welding method, purity of weld atmosphere, and subsequent heat treatment on the ductility of welded 0.030 inch thick sheets of columbium and tantalum base alloys, Cb–1% Zr, Cb-752, B-33, FS-85, D-43, T-111, and T-222, as measured by a room temperature bend test. Bead-on-plate welds were made by the electron-beam process or the gas tungsten-arc (TIG) process in argon atmosphere containing either 2- to 4-ppm oxygen with moisture level ranging from 5 to 19 ppm or approximately 100 ppm oxygen (moisture not monitored). Additional heat treatments and aging conditions similar to those that might be encountered during fabrication or use of these materials in test space-power systems were imposed on some of the specimens before bending. Author

N65-24785# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
PILOT PRODUCTION AND EVALUATION OF TANTALUM ALLOY SHEET Ninth Quarterly Report, 28 Jul.–28 Oct. 1964
R. L. Ammon and A. M. Filippi 28 Dec. 1964 19 p refs
(Contract NOw-64-0394-d)
(WANL-PR-M-011; AD-610471)

Fabrication and melting of the first melt electrodes of T-222 are described. The first melt ingots have been fabricated into second melt electrodes for the production of 4-inch-diameter ingots. A phase identification study has confirmed the presence of carbide phases in T-222 after various solution and aging treatments. The dimetal carbide, which is predominately Ta_2C, is stable in solution-treated T-222 at temperatures up to 2400° F, while a monocarbide phase which is predominately HfC_{1-x} is stable at higher temperatures. It has also been confirmed that prior deformation favors the precipitation of the hafnium-rich monocarbide at temperatures below 2400° F. Author

N65-24806# IIT Research Inst., Chicago, Ill. Technology Center
INTERFACE FRICTION IN HOT METAL DEFORMATION Bimonthly Report, Jan. 24–Mar. 23, 1965
John A. Schey 23 Apr. 1965 6 p
(Contract NOw-64-0458-f)
(IITRI-B6027-5; AD-463143)

The friction phenomena encountered during the hot deformation processing of metal is investigated. The 7075 Al and Alclad 7075 Al workpiece materials have been deformed in plane-strain compression with WC, 4340 steel, chromallized 4340 steel, boronized 4340 steel, 1.5 Cb–TZM, Inconel X750, and Al_2O_3 as work surface materials. The 6Al-4V-Ti has also been deformed using WC, 4340 steel, and boronized 4340 steel as work surfaces. Coefficient-of-friction values and reference curves have been obtained for each of the workpiece materials. N.E.A.

N65-24838# Battelle Memorial Inst., Columbus, Ohio.
STEELS FOR PIPING SYSTEMS WITH MAXIMUM PRESSURES OF 10000 PSI, AND OPERATING BETWEEN −150°F AND +150°F
H. W. Mishler Huntsville, Ala., Army Missile Command, 2 Nov. 1964 44 p refs
(Contract DA-01-021-AMC-203(Z))
(RSIC-327; AD-459403)

The results are presented of a survey that was made to find commercially available steels applicable for use in welded high-pressure piping systems. These systems operate at internal pressures of 3500 to 10000 psi and temperatures from −150° to +150° F. The steel must be capable of being welded with little or no preheat and should be satisfactory for service without a postwelding stress-relief treatment. Two steels, low-carbon 9% nickel and HY-80, will meet the requirements for this application. The low-carbon 9% nickel steel can be welded with no preheat. Weld joints in the as-welded condition have excellent low-temperature impact properties, good ductility, tensile strength of approximately 95000 psi, and yield strength of approximately 60000 psi. The HY-80 steel is welded with a 200° F maximum preheat, and it is possible to weld joints that have tensile strength of 130000 psi and yield strength of 110000 psi, good ductility, and good low-temperature impact strengths. Thick-walled seamless pipe made from the low-carbon 9%-nickel-steel pipe is commercially available. The HY-80 seamless pipe must be ordered specially. Author

N65-24870# Bureau of Mines, Boulder City, Nev. Boulder City Metallurgy Research Lab.

ELECTROREFINING VANADIUM IN A MOLTEN BROMIDE ELECTROLYTE

T. A. Sullivan and F. R. Cattoir 1965 16 p refs
(BM-RI-6631)

High-purity vanadium metal was prepared by electrorefining commercial vanadium in a molten bromide, potassium bromide, and vanadium dibromide electrolyte. Variables investigated were operating temperature, current densities, electrolyte composition, and condition of the anode. The purity of the refined metal was in the range of 99.95 percent vanadium. Iron and oxygen in the 50- to 250-ppm range were the only major impurities. Metal with hardness numbers of 50 to 60 in the Rockwell F scale was prepared from feed material with a Rockwell B hardness of 90. The arc-melted metal was highly ductile and could be cold-worked into sheet or foil.

Author

N65-24956# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

PHYSICAL AND MECHANICAL METALLURGY STUDIES ON DELTA STABILIZED PLUTONIUM–GALLIUM ALLOYS

H. R. Gardner Apr. 1965 74 p refs
(Contract AT(45-1)-1830)
(BNWL-13)

The effects of certain metallurgical phenomena on the physical and mechanical properties of delta stabilized Pu–Ga alloys were investigated. Particular studies include the liquid plus epsilon and epsilon plus delta coring contribution to the resultant Ga concentration gradient, the effect of Ga content on selected physical and mechanical properties, and the recrystallization kinetics of cold rolled alloy. Coring occurring in the epsilon plus delta region controls the alloy homogenization. The homogenization rate is temperature dependent and an inverse function of cored grain size which is controlled by cooling rate through the epsilon plus delta region. Alpha plus delta phase mixtures in the cored alloys were unstable and homogenized alloys were stable during room temperature storage after annealing below 280° C. Lattice parameter, density, and pressure metastability in homogeneous alloys decreased while hardness increased as Ga content increased. Recrystallization occurred at 250° C on 94% cold rolled alloy. Tensile, compressive, strain hardening, and fatigue test results are given.

R.N.A.

N65-24957# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

PHYSICAL PROPERTY CHANGES IN THORIUM POSTIRRADIATION ANNEALED TO 950 C

R. D. Leggett Jan. 1965 22 p refs
(Contract AT(45-1)-1830)
(BNWL-24)

The mechanical properties of irradiated thorium tested in tension at 590° and 815°, and the swelling characteristics of the grip ends of broken tensile specimens subjected to postirradiation annealing are described. Irradiation doubled the yield strength, and reduced the strain hardenability and percent total elongation. Most of the area reduction occurred at 590° C, which may be due to segregation of fission products to the grain boundaries at 815° C. Metallographic examination revealed severe fragmentation of oxide inclusions in a very high burnup. Thorium's excellent mechanical properties after irradiation are attributable to its isotropic crystal structure while its swelling resistance may be a result of its high melting point.

R.N.A.

N65-24959# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

ELECTRON MICROSCOPE STUDIES OF SECOND PHASE PARTICLES IN DILUTE ALLOYS OF URANIUM

T. K. Bierlein, B. Mastel, and C. L. Corey Mar. 1965 10 p refs
(Contract AT(45-1)-1830)
(BNWL-43)

Transmission electron microscopy techniques for determining particle size and density in uranium rich alloys are described and corroborated with results obtained by replica electron microscopy. Particle shapes could not be determined but were presumed to be round because rod and plate-like particles were not observed. Particle diameters measured by transmission micrographs were in good agreement with replica techniques. Most particles were opaque and many were of the same size as dislocations and loops and therefore could not be measured. Density estimates for particles with diameters greater than 800 Å were also in good agreement with replica techniques. However for particles with diameters smaller than 800 Å, the density estimate was three orders of magnitude greater which clearly emphasizes the value of high resolution electron transmission microscopy techniques over replica methods in determining particle size and density.

R.N.A.

N65-25121# Joint Publications Research Service, Washington, D. C.

STUDIES IN LOW-ALLOY PEARLITIC STEELS AND HIGHLY COERCIVE Fe-Ni-Al BASE ALLOYS

31 May 1965 23 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Mashinostro. (Moscow), Mar. 1965
(JPRS-30340; TT-65-31123) CFSTI: $1.00

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1. NEW HEAT-RESISTING PEARLITIC STEELS FOR POWER MACHINE BUILDING I. L. Mirkin and L. P. Trusov p 1–8 refs (See N65-25122 14-17)

2. THE STRUCTURE, MAGNETIC PROPERTIES AND NEW PRODUCTION METHODS OF SOME HIGHLY COERCIVE Fe-Ni-Al BASE ALLOYS N. G. Shul'ga, P. D. Afanas'yev, and S. K. Yaremkevich p 9-20 refs (See N65-25123 14-17)

N65-25122 Joint Publications Research Service, Washington, D. C.

NEW HEAT-RESISTING PEARLITIC STEELS FOR POWER MACHINE BUILDING

I. L. Mirkin and L. P. Trusov *In its* Studies in Low-Alloy Pearlitic Steels and Highly Coercive Fe–Ni–Al Base Alloys 31 May 1965 p 1–8 refs (See N65-25121 14-17) CFSTI: $1.00

General data are presented concerning the development of low alloy grades of heat-resistant steel of the pearlitic class, the advantages and properties of chromium, molybdenum, and vanadium steels, and the means of a further increase in the level of heat resistant properties of low alloy steels for heat engineering.

Author

N65-25123 Joint Publications Research Service, Washington, D. C.

THE STRUCTURE, MAGNETIC PROPERTIES AND NEW PRODUCTION METHODS OF SOME HIGHLY COERCIVE Fe–Ni–Al BASE ALLOYS

N. G. Shul'ga, P. D. Afanas'yev, and S. K. Yaremkevich *In its* Studies in Low-Alloy Pearlitic Steels and Highly Coercive Fe–Ni–Al Base Alloys 31 May 1965 p 9–20 refs (See N65-25121 14-17) CFSTI: $1.00

The basic assumptions concerning the structure and magnetic properties of, as well as methods for, studying highly coercive Fe–Ni–Al and Fe–Ni–Al–Co alloys are discussed. Use of the Hall effect, as well as an electronic oscillograph, for examining the basic properties is described. Some light is thrown on the interrelationship of the structure and magnetic properties of the alloys, and some means for speeding up the magnetic analyses are presented. Author

N65-25156# United Kingdom Atomic Energy Authority, Risley (England). Reactor Materials Lab.
APPLICATION OF THE EQUIVALENT DOSE AND TEMPERATURE CONCEPTS TO IRRADIATION-INDUCED CHANGES IN THE MECHANICAL PROPERTIES OF STEEL
H. Bridge and B. T. Kelly 1965 21 p refs
(TRG-511(C)) HMSO: 3s 6d

The concepts of equivalent dose and equivalent temperature, already used successfully to correlate irradiation damage rates in graphite from different irradiation facilities, are described. The method of application of these concepts to irradiation-induced property changes in iron and steel is discussed, and the Kinchin and Pease damage model together with calculated neutron spectra are used to illustrate the system of equivalent dose estimation. It is concluded that the data available are not adequate to provide an acceptable value of the activation energy to be used in the equivalent temperature correction; order of magnitude calculations of this effect are performed. A discussion is given of possible reasons for the failure of these concepts when applied to the yield point and ductile–brittle transition temperature of steels, and it is concluded that it is essential to test these concepts experimentally. It is suggested that the system be adopted as an interim measure. Author

N65-25158# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group
HIGH-PRECISION DENSITY MEASUREMENTS ON IRRADIATED URANIUM CARBIDES
G. Childs and K. Buxton 1965 31 p refs
(TRG-862(D)) HMSO: 4s 6d

Techniques are described by which the density of irradiated uranium carbide specimens, 0.15 cm^3 in volume, can be measured to an accuracy of about 2 parts in 10^4. The variation in density with neutron exposure, observed for a number of specimens irradiated at 50° C, was found to agree in general with that calculated from the corresponding changes in lattice parameter for similar specimens. Negligible internal cracking or microscopic pore or bubble formation thus occurred in the specimens. Subsequent density changes, which occurred when the specimens were annealed, were found to depend critically on variables such as specimen composition and neutron exposure. This suggests that the annealing behavior of irradiated uranium carbide is more complex than has hitherto been supposed. Author

N65-25167# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
THE FABRICATION OF $(UPu)O_2$—STAINLESS STEEL CERMETS FOR IRRADIATION
J. P. Evans Feb. 1965 26 p refs
(AERE-M-1314)

The development and fabrication of cermet irradiation specimens are described. The cermets contained 30, 40, and 50 vol.% $(U_{0.75}Pu_{0.25})O_2$ in Type 316L stainless steel. They were prepared by cold pressing and sintering, or by hot pressing, in order to study certain structural variables. The methods used are not typical of those which would be recommended at the present time. Author

N65-25233# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
BERYLLIUM: REVIEW OF RECENT DEVELOPMENTS
Hugh D. Hanes 21 May 1965 3 p refs

Recent developments in the physical metallurgy, mechanical properties, and fabrication of beryllium are reviewed. Among the items considered was the application of zone-leveling as a technique for producing single crystals of intermediate purity. Properties of the single crystals were found to improve with decreased rate of zone travel but not with increased number of zone passes. Zone leveling was also applied to commercial grade powder-metallurgy beryllium. The zone leveling was done in the solid state. The effect of strain rate on the high-temperature ductility of hot-pressed beryllium was also reported. The tests were conducted at 700° to 1400° F at strain rates of 0.001 to 3 inch/inch/sec. In general, ductility increased with increasing strain rate. Further, hypervelocity impact properties of beryllium and other brittle materials were reviewed. Both flat plates and duplex tubes of beryllium were impacted with 3/32-inch Pyrex spheres at 25 000 ft/sec to simulate potential meteoroid damage. Impacts of this type produce a hemispherical crater surrounded by an area of spalling. Secondary damage including radial fracturing and rear-surface spall was also noted in the disks. E.E.B.

N65-25249*# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. Materials Research and Development Dept.
GENERATION OF LONG TIME CREEP DATA OF REFRACTORY ALLOYS AT ELEVATED TEMPERATURES Seventh Quarterly Report, 26 Dec. 1964–26 Mar. 1965
J. C. Sawyer and C. H. Philleo 28 Apr. 1965 41 p refs
(Contract NAS3-2545)
(NASA-CR-54393) CFSTI: HC $2.00/MF $0.50

Ultra-high-vacuum creep data are presented for tungsten, tungsten–25% rhenium, TZM and TZC molybdenum alloys, and AS-30 columbium alloy. TZC alloy exhibits the greatest creep strength of the turbine alloys examined, and has been selected for the initial 10 000-hour creep tests. Author

N65-25275*# Curtiss-Wright Corp., Caldwell, N. J.
AN APPROACH TO METAL FATIGUE
F. B. Stulen, J. H. Redfern, and W. C. Schulte Washington, NASA, Jun. 1965 86 p refs
(Contract NAS1-3170)
(NASA-CR-246) CFSTI: HC $3.00/MF $0.75

Factors that are of primary importance in the fatigue of metals were investigated. The material used was titanium 8 Al–1 Mo–1 V alloy sheet in the Triplex-Annealed condition. Three phases were examined: (1) the fatigue limit associated with a crack; (2) the rate of crack propagation; and (3) the stress interaction effect, or the delay-cycle effect. Each of these effects is described by one or more proposed formulas, and the parameters associated with each were obtained by standard statistical methods. The rms-error between the test data and the corresponding computed values was employed as a measure of the goodness-of-fit of the proposed formulas. Reasonably good fits were obtained between the test data and some of the proposed relations. A cumulative fatigue damage relation was developed based on these findings. Author

N65-25305# Mallinckrodt Chemical Works, Weldon Spring, Mo. Uranium Div.
EFFECT OF ALLOY ADDITIONS ON THE QUENCH-INDUCED TEXTURE OF ALPHA-URANIUM
K. R. Riggs and N. F. Neumann 16 Apr. 1965 45 p refs
(Contract W-14-108-ENG-8)
(MCW-1491) CFSTI: $2.00

The effect of quench rate upon textures in dilute alloys of aluminum, chromium, iron, and silicon in uranium was studied. Inverse pole figure techniques for measuring orientation were applied to Jominy-type experiments. Proposed mechanisms for the introduction of preferred orientation by different cooling rates were developed. Author

N65-25308# Battelle-Northwest, Richland, Wash. Reactor and Materials Technology Dept.
THE EFFECT OF NEUTRON IRRADIATION ON SLIP-LINES IN MOLYBDENUM
J. L. Brimhall Mar. 1965 18 p refs
(Contract AT(45-1)-1830)
(BNWL-44)

The nature and homogeneity of the slip line structure in an irradiated molybdenum single crystal deformed by bending and a comparison of this behavior with an unirradiated similarly deformed crystal were investigated. The slip line formation was studied as a function of strain, orientation, and carbon content of the specimen. Correlations were made between the surface slip line structure and bulk structure as observed by transmission electron microscopy. In comparing equivalent strains, the slip lines of the irradiated molybdenum are coarse and distinct while the unirradiated molybdenum lines are not resolvable. Defect free channels form in the irradiated material during deformation and the slip lines are directly correlated with these dislocation channels. The heterogeneous distribution of the dislocations during deformation in the irradiated material results from dislocation interaction with the defects produced during irradiation. Carbid impurities affect the dislocation channeling by acting as dislocation sources. R.N.A.

N65-25319# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
TUNGSTEN AND TUNGSTEN-BASE ALLOYS
V. D. Barth 28 May 1965 6 p refs

Recent developments in tungsten and tungsten-base alloys are reviewed. Hydrometallurgical procedures, tube-making and hydrostatic extrusion fabrication processes, powder compacting and sintering, mechanical strength of various alloys, crystal structure, composite structure, and oxidation are discussed. R.N.A.

N65-25336# Battelle Memorial Inst., Columbus, Defense Metals Information Center
RECENT INFORMATION ON LONG-TIME CREEP DATA FOR COLUMBIUM ALLOYS
Jerome J. English and Edwin S. Bartlett 26 Apr. 1965 8 p refs
(Contract AF 33(615)-1121)
(DMIC-Memo-203)

Data on long-time creep behavior of numerous columbium alloys investigated at vacuums from 10^{-7} to 10^{-10} torr are presented. Long-time creep behavior was also studied for columbium alloys which were coated with silicides, and for which elongation was measured before and after stress was applied; it was found that both the coating and the coating process can affect creep behavior, that at higher temperatures better coating performance was obtained in the stressed condition, and that the creep behavior of an alloy is dependent on the coating and coating process used to protect the alloy from oxidation. J.M.D.

N65-25345# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
FIBER-REINFORCED METALS
H. J. Wagner 4 Jun. 1965 2 p refs

Recent developments in fiber-reinforced metals are reviewed. Bonding in whisker-reinforced metals, fiber reinforcement mechanisms, wire-reinforced nickel and titanium alloys, alumina-reinforced nickel–chromium alloys, sapphire wool-reinforced composites, and alumina–whisker nickel–palladium composites are discussed. R.N.A.

N65-25367# Canadian Armament Research and Development Establishment, Valcartier (Quebec).
URANIUM AND URANIUM ALLOYS
H. P. Tardif and P. Perron Aug. 1964 43 p refs
(CARDE-TR-497/64)

A brief survey is made of the main physical, chemical, and mechanical characteristics of both natural and depleted uranium. The various techniques used for the processing of uranium are presented. Heat-treatable uranium alloys which may have sufficiently high mechanical properties to be of interest in armament are considered. Author

N65-25383# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics
ON SECOND ORDER STRAIN ACCUMULATION IN TORSION FATIGUE Technical Report No. 16
Maria Ronay Feb. 1965 60 p refs
(Contract Nonr-266(91))
(TR-16; AD-612712)

A quadratic relation has been found between the accumulated second order axial strain to the start of macroscopic crack propagation and the reversed torsion angle producing it. Second order strain accumulation has also been found in Armco iron both below and above the yield range in the range axial strain accumulation is erratic. The superposition of axial stress on the reversed cyclic torsion amplifies the second order strain accumulation. For aluminum and Armco iron a linear relation exists between the accumulated axial strain at any torsion angle and the applied axial stress as well as between the accumulated axial strain at any axial stress and the applied torsion angle. Fatigue life has been related to the second order strain accumulation. Author

N65-25384# Frankford Arsenal, Philadelphia, Pa.
STRESS CORROSION TESTS OF SOME WROUGHT Mg-Li BASE ALLOYS
John C. Kiszka Jul. 1964 17 p refs
(FA-M65-1-1; AD-610292)

Seven experimental wrought Mg-Li base alloys (Mg-14Li with various additions of Al, Zn, Ag, and/or Si) were tested for stress-corrosion susceptibility in humid air, following mechanical and thermal processing to approximate conditions in the heat-affected zone of a weld. Stress levels during exposure were uncertain because of creep effects. Rapid cooling from 700° F rendered susceptible those alloys containing aluminum regardless of other alloy content. However, heating for 24 hours at 300° F following such rapid cooling restored their resistance to stress corrosion. Alloys strengthened by additions

of zinc, silicon, and/or silver, but with aluminum excluded, did not fail in stress corrosion under the conditions of test used in this study. Author

N65-25385# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
INVESTIGATION OF BONDING IN OXIDE-FIBER (WHISKER) REINFORCED METALS Seventh Quarterly Report, 1 Jan.–31 Mar. 1964
Willard H. Sutton Watertown, Mass., AMRA, Mar. 1964 22 p refs
(Contract DA-36-034-ORD-3768Z)
(AMRA-CR-63-01/7; AD-607984)

The effects of various additives to nickel on its wetting and adherence to sapphire (α-Al_2O_3) were investigated by preparing special binary alloys containing one atomic percent of Al, Cu, In, Ti, Zr, and Cr. Sessile drop experiments were conducted in vacuo (5×10^{-6} torr) at 1480° to 1500° C in order to observe the contact angles and the degree of wetting. Shear tests were conducted on the solidified sessile drops of nickel. Values as high as 25000 psi were recorded for the nickel drop with chromium. Author

N65-25422# Battelle Memorial Inst., Columbus, Ohio.
FURTHER INVESTIGATION ON NOTCH SENSITIVITY OF REFRACTORY METALS Bimonthly Progress Report, Oct. 1–Nov. 30, 1964
C. W. Marschall, F. C. Holden, A. Gilbert, and B. A. Wilcox 10 Dec. 1964 16 p refs
(Contract AF 33(657)-10363)
(BPR-4; AD-462863)

Fracture-toughness studies are made on coated TZM–Mo alloy and D43–Cb alloy to evaluate the effect of protective coatings on this material parameter. Stress–strain curves of recrystallized Mo sheet obtained on a high strain rate tensile-testing machine are presented, and the most recent data on crack-stop tests in wrought stress-relieved Mo sheet summarized. Author

N65-25472# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
STATIC TESTS OF CORROSION INHIBITORS FOR ALUMINUM AND CARBON STEEL
R. B. Richman Feb. 1965 28 p refs
(Contract AT(45-1)-1830)
(BNWL-29) CFSTI: $2.00

Uniform corrosion losses and pitting tendencies were measured for carbon steel and aluminum samples exposed for as long as 9 1/2 months at ambient temperature in static, non-refreshed solutions of 38 different inhibitor mixtures. Results from these tests indicate that two inhibitors, (1) sodium hexameta-phosphate, and (2) sodium nitrite plus sodium silicate, are possible candidates to replace sodium dichromate in dynamic or static systems that contain both carbon steel and aluminum. Three additional inhibitors reduced the uniform corrosion of carbon steel. Limited measurements of inhibitor depletion were obtained, but the effects of this depletion on corrosion were not defined. Candidate mixtures should be tested in dynamic systems at temperatures typical of Hanford reactor operation, to confirm the indications of satisfactory corrosion inhibition shown by these static tests. Author

N65-25501# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
THE EFFECTS OF CONTAMINATION ON THE OXIDATION OF ZIRCONIUM IN STEAM
J. T. Demant and J. N. Wanklyn Mar. 1965 27 p refs
(AERE-R-4788)

Initial oxidation of zirconium in steam at 500° C, 1 atm is considerably accelerated by contamination deposited on the metal surface during vacuum annealing in silica capsules. Radioactivation analysis shows that copper is transferred from silica to zirconium. The layer of affected metal, less than 10μ thick, may be removed by electropolishing. A clean surface with a low initial oxidation rate is produced by electropolishing followed by rinsing in methanol. Accelerated oxidation results when electropolished surfaces are dipped in aqueous solutions of several cations, including copper, or when they are given the normal HNO_3/HF pickle followed by tap water rinsing. Simple immersion in tap or redistilled waters can also accelerate oxidation, probably due to the calcium present; but exposure to HF solution with rigorous exclusion of calcium, appears to have no effect. Implications of results, for oxidation studies and corrosion testing, are discussed. Author

N65-25504# United Kingdom Atomic Energy Authority, Harwell (England). Library
STUDIES ON CARBIDES IN IRON AND STEEL BY ELECTROLYTIC ISOLATION. 4: BEHAVIOUR OF CEMENTITE DURING COLD-WORKING AND ANNEALING
Tomoo Sato and Taiji Nishizawa Nov. 1964 11 p refs Transl. into ENGLISH from Nippon Kinzoku Gakkaishi (Sendai City), vol. 20, no. 1, 1956 p 51–55
(AERE-TRANS-1017) HMSO: 2s 6d

Electron-microscopic examinations were carried out on cementite isolated from annealed, cold-rolled, and subsequently annealed 0.65% carbon steels, and the behaviors of cementite during these treatments were studied, with the following results: (1) During cold deformation of steel, a cementite crystal in the steel curves elastically, and then splits along its cleavage into many laminar fragments. The width of the split laminae lies in the range from 1500 to 3000 Å, and these laminae themselves show a fibrous structure, having a width of about 300 Å. In the case of spheroidal pearlite, however, the cementite globules suffer no change in the process of cold rolling. (2) Due to annealing after cold rolling, a crystalline cementite is spheroidized through three stages—incubation, nucleation, and growth. (3) During prolonged annealing of normalized steel at a subcritical temperature, a crystalline cementite in it undergoes local thickening and thinning, and finally separates into several cementite globules. The spheroidization of cementite in this case may be caused by surface tension and lattice imperfection inherent in the cementite. Author

N65-25512# Joint Publications Research Service, Washington, D. C.
A STAINLESS STEEL WITH A HIGH THERMAL NEUTRON CAPTURE CROSS SECTION
I. S. Lupakov et al 8 Jun. 1965 8 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 18, no. 3, Mar. 1965 p 242–245
(JPRS-30468; TT-65-31185) CFSTI: $1.00

Described are the engineering and mechanical characteristics of a new stainless austenitic steel with a relatively high thermal neutron capture cross section. Holding of test samples at 350° C for 4000 hrs did not cause any marked changes and indicated satisfactory stability of the steel's structure. The corrosion rate in deaerated water dropped with an increase in time and was not changed essentially by an increased oxygen content. Test specimens were satisfactorily welded by electric arc, argon arc, and contact welding, and all welding, and all welds showed high strength. G.G.

N65-25517# Oak Ridge National Lab., Tenn.
TYPE 316 STAINLESS STEEL, INCONEL, AND HAYNES ALLOY NO. 25 NATURAL-CIRCULATION BOILING-POTASSIUM CORROSION TEST LOOPS
D. H. Jansen and E. E. Hoffman Jun. 1965 102 p refs
(Contract W-7405-ENG-26)
(ORNL-3790) CFSTI: $4.00

An investigation was undertaken to determine the compatibility of conventional nickel-, iron-, and cobalt-base high-temperature alloys with boiling potassium. The tests were designed to obtain quantitative information on the dissolution of the container alloys by condensing potassium and the subsequent deposition of solute in a subcooled liquid region of the test device. Studies were conducted in natural-circulation loops, two of which were fabricated from type 316 stainless steel, two from Haynes alloy No. 25, and one from Inconel. Each of the alloys was operated at a maximum boiler-condenser temperature of 870° C for 1500 to 3000 hr, and the Haynes alloy No. 25 was also tested for 3000 hr at 980° C. The potassium condensing rates at the two temperatures were 170 to 180 and 300 g/min, respectively. At 870° C, type 316 stainless steel and Haynes alloy No. 25 exhibited comparable resistance to attack by boiling potassium, while Inconel showed greater deterioration. Carbon was transferred from the condensing region to the subcooled liquid region in all the loop tests. Attendant with this, the elongation of the material decreased and the tensile strength increased. No evidence of preferential leaching of major metallic constituents of these alloys was detected by electron microprobe analysis of the condenser surfaces. However, limited mass transfer from the hot region to the cold region was noted. Author

N65-25539# Joint Publications Research Service, Washington, D. C.
ALUMINUM ALLOY DESIGN—HANDBOOK DATA
Zinoviy Il'ich Braude, Aleksey Grigor'yevich Lyapin, and Nikolay Vasil'yevich Topilin 8 Jun. 1965 19 p Transl. into ENGLISH from the book "Konstruktsii iz Alyuminiyevykh Splavov—Spravochnyye Materialy" Moscow, Stroyizdat, 1964 p 8–18,63–67, 77, 88
(JPRS-30484; TT-65-31195) CFSTI: $1.00

Presented is a translation of three excerpts from the Russian language book *Aluminum Alloy Design—Handbook Data*. Included are an analysis of aluminum alloys used in construction designs; the design of nontypical construction profiles; and the use of aluminum alloys in the fabrication of rivets, bolts, electrodes, and cements. Considered is the effect of chemical elements on the properties of aluminum alloys, deformed and casting alloys; semifinished products made from aluminum alloys; inherent problems in the design of nontypical profiles such as stained glass, light stand panels, and suspended ceilings; and welding techniques. S.C.W.

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N65-24436# Joint Publications Research Service, Washington, D. C.
USE OF POLYMERIC MATERIALS FOR THE MANUFACTURE AND PROTECTION OF CHEMOPHARMACEUTICAL EQUIPMENT
Yu. P. Aronson 27 May 1965 17 p refs Transl. into ENGLISH from Med. Prom. SSSR (Moscow), no. 1, 1965 p 7–16
(JPRS-30290; TT-65-31101) CFSTI: $1.00

The polymeric materials (plastics) used in chemical machine building are divided into four groups: thermosetting materials, thermoplastic materials, elastomers, and compositions of polymeric materials with inorganic materials such as silicates, graphite, and glass fiber. A description and the uses of the new nonmetallic materials in the four groups are presented. N.E.A.

N65-24438# National Cash Register Co., Dayton, Ohio.
ENCAPSULATED FOAM FOR AEROSPACE SUPPORT APPLICATIONS Technical Report, Jun. 1962–May 1964
Lawrence R. Lankston and James A. Wrede Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Dec. 1964 245 p refs
(Contract AF 33(657)-8961)
(AFAPL-TR-64-139; AD-610538)

The objective was to rigidize flexible structures in an aerospace environment with rigid polyurethane foams. Vacuum shelf life, were developed to achieve this objective. Foams were to separate the reactive materials and provide a satisfactory self life, were developed to achieve this objective. Foams were produced at reduced pressures of at least 1×10^{-6} torr, utilizing single package, capsule-containing formulations. Heat was used to activate the formulations. A 1.0-ft sphere, a 2.0-ft shelter, the floor of a 7.0-ft shelter, and numerous small solar collectors were rigidized with these systems. An alternate rigidizing system was developed that involved the rigidization of a preformed flexible foam using the preparation of a polyester as the rigidizing mechanism. This technique was successfully applied to model solar energy collectors in vacuum. Author

N65-24494 Joint Publications Research Service, Washington, D. C.
ADHESION BETWEEN NATURAL RUBBER AND SOFT POLYVINYL CHLORIDE. I: NATURAL RUBBER—METHYL METHACRYLATE—VINYL ACETATE COPOLYMER SYSTEM
Chen-yun Lu and Chih-lu Wang *In its* Transl. on Communist China's Sci. and Technol., No. 178 10 May 1965 p 1–7 refs Transl. into ENGLISH from Hua-hsueh T'ung-pao (Peking), no. 10, 14 Oct. 1964 p 50–52 (See N65-24493 14-06)
CFSTI: $3.00

The adhesion between natural rubber and soft polyvinyl chloride is discussed. The synthesis of a colloid adhesive paste, the adhesion technique, and testing of the final product are considered. It was concluded that the copolymer of natural rubber, methyl methacrylate, and vinyl acetate are comparatively satisfactory when used with unlike polarity polymer materials. The average stripping strength of natural rubber joined with polyvinyl chloride was found to be more than 17 kg/cm. The copolymer system adhesion, joining natural rubber and soft polyvinyl chloride, was considered to result from diffusion of the rubber molecule bonds of the copolymer adhesive into the surface of the rubber by Brownian movement. In the vulcanization process, the molecules interlock and intertwine. E.E.B.

N65-24572# Naval Ordnance Lab., White Oak, Md.
GLASS FIBER SURFACE TREATMENTS: THEORIES AND NAVY RESEARCH

Porter W. Erickson Feb. 1964 27 p refs
(NOLTR-63-253; AD-426292)

This report reviews and discusses the current status of both old and new theories to explain the mechanism of finishes at the glass–resin interface in reinforced plastics. All evidence for and against the chemical bonding theory is cited and examined in view of the fact that this is still the only theory which predicts chemical finish structures which lead to improved laminate strengths. Recent and current studies concerned with the resin–glass bond and stronger reinforced plastics are reviewed. Author

N65-24591# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.
COMPARISON OF THERMAL DEGRADATION BEHAVIOR OF A CONVENTIONAL AND A FLUORINATED EPOXIDE RESIN
Hsueh T. Lee, Leo Reich, and David W. Levi May 1965 26 p refs
(PA-TR-3194; AD-462415)

A fluorinated bisphenol based on the condensation product of hexafluoroacetone and phenol was epoxidized. Thermal degradation of the uncured and m-phenylenediamine cured resin was compared with that of a commercial epoxide resin; their thermal stability based on the overall activation energy for the degradation process, was essentially the same. Two recently proposed methods for the evaluation of overall activation energy and reaction order are applied and discussed. Author

N65-24604# Hitemp Wires Co., Westbury, N. Y.
TEFLON-PYRE ML WIRE INSULATION SYSTEM
J. R. Learn and M. P. Seegers [1964] 17 p Presented at the 13th Symp. on Tech. Progr. in Commun. Wire and Cables, Atlantic City, 2–4 Dec. 1964
(AD-458555)

An intensive investigation has shown that Teflon tetrafluoroethylene (TFE) and fluorinated ethylene propylene (FEP) wires could qualify for more severe service requirements if some of the physical properties were improved. It was found that a thin film of Pyre ML polyimide resin integrally bonded to the outer TFE or FEP surface gives a system with substantially improved physical properties. The temperature rating of this system is the same as that of the primary insulation. This construction adds high abrasion and cutthrough to the thermal and chemical resistance with only slight increase in weight and dimensions. The increased high-temperature cutthrough is especially beneficial in protecting FEP wire against solder iron damage. In addition to improved mechanical properties, the Teflon–Pyre ML system withstands extremely high and low temperatures, as well as hard vacuum conditions. Bonding strength to potting compounds is excellent. This wire qualifies for applications which standard TFE or FEP insulated wires cannot meet. Author

N65-24787# Stanford Univ., Calif. Div. of Engineering Mechanics
NONLINEAR VISCOELASTICITY FOR SHORT TIME RANGES Contract Report No. 6
N. C. Huang and E. H. Lee Nov. 1964 44 p refs
(Contract Nonr-225(69))
(TR-151; AD-610818)

Approximate constitutive equations for nonlinear viscoelastic incompressible materials under small finite deformation and for short time ranges are derived. The error bound of such a constitutive equation is investigated. Problems of nonlinear stress relaxation and creep are analyzed based on the proposed equation. Also, the problem of a pressurized viscoelastic hollow cylinder bonded to an elastic casing is solved. Numerical solutions, evaluated by assuming particular forms of kernel functions in the constitutive equation, are obtained by means of an inverse interpolation technique, and the effects of nonlinearity of material properties are discussed. An experimental procedure is also proposed for measuring kernel functions from uniaxial tension tests for real materials. Author

N65-24814# Monsanto Research Corp., Everett, Mass. Boston Lab.
PHYSICAL AND RHEOLOGICAL PROPERTIES OF NITROSO RUBBERS Quarterly Report No. 4, 25 Mar.–24 Jun. 1964
G. L. Ball, III and L. Gilman 24 Jul. 1964 23 p refs
(Contract DA-19-129-AMC-151(N))
(MRB4013Q4; AD-461291)

A physical property characterization program was initiated for fluorinated nitroso rubber. A complete literature survey was conducted and compiled. Three solvents were found to be usable for solution viscosity and intrinsic viscosity measurements. The best is a commercial mixture of isomers of octylperfluorocyclic ethers. Viscosity measurements on an available sample indicated a molecular weight of 361 000. Lack of a really good solvent hindered the fingerprinting procedure, but nuclear magnetic resonance spectra were obtained, and thermogravimetric analysis showed a weight loss from 75° C up, as well as a definite depolymerization at 270° C. Author

N65-24815# Monsanto Research Corp., Everett, Mass. Boston Lab.
PHYSICAL AND RHEOLOGICAL PROPERTIES OF NITROSO RUBBERS Quarterly Report No. 5, 25 Jun.–24 Sep. 1964
G. L. Ball, III, L. Gilman, H. S. Wilson, and I. O. Salyer 24 Oct. 1964 19 p refs
(Contract DA-19-129-AMC-151(N))
(MRB4013Q5; AD-461292)

Two nitroso gum samples were characterized as to molecular weight and similarity. Intrinsic viscosity measurements indicated molecular weights of from 1.38×10^6 to 1.57×10^6 Insoluble content varied from 6 to 37 percent, and fingerprinting by solution viscosity indicated that the two nitroso gums were different. Three solvents, FC-75, FC-43, and Freon 113, proved adequate for viscosity measurements. Light scattering measurements on an old 3M-produced gum indicated an average molecular weight of 400 000 as was predicted from viscosity measurements. Author

N65-24823 Jet Propulsion Lab., Calif., Inst. of Tech., Pasadena.
RUPTURE OF ELASTOMERS AND PROPELLANTS
Robert F. Landel *In* Calif. Inst. of Tech., Solid Rocket Structural Integrity Abstr., Vol. II, No. 1 Jan. 1965 p 1–22 refs (See N65-24822 14-27)

Rupture or fracture initiation in amorphous polymers, both filed and unfilled, above glass transition temperature was reviewed. The stress in a uniaxial experiment depends on the modulus, time, temperature, crosslink density, form of the stress stain curve, type and content of filler, degree of dewetting from the filler, percent crystallinity and whether the crystallites are initially present or developed on straining. As a convenient frame of reference the concept of the physical property surface was adopted, i.e., the three-dimensional surface generated by a plot of stress, strain, and reduced time. The implication that progressive weakening prior to rupture appears to be true for unfilled elastomers subjected to simple loading histories

but is not true for filled systems, therefore the surface for a propellant was defined on a first and second stretch surface and Landel's ad hoc definition of failures was used. An extensive annotated bibliography is appended. In summarizing, failure discussions should consider the form of the stress-strain curve (the physical property surface) and the failure envelope. R.W.H.

N65-24930 Corning Glass Works, N. Y.
MODERN GLASS
S. Donald Stookey *In* Smithsonian Inst. Ann. Rept. of the Smithsonian Inst., 1962 [1962] p 323-335 (See N65-24925 14-34) GPO: $4.75

Discussions of the newly evolving technology of glass are prefaced by considerations of the nature of glass and its properties. The influence of molecular structure is becoming increasingly more evident in the development of glasses that respond to light, glass ceramics, producing glass armored by a transparent skin of negative-expansion glass-ceramic, molecular sieve and ion exchange applications, nucleation and electronic conduction, and radiation-resistant amorphous silicaglass. M.P.G.

N65-25199# Aberdeen Proving Ground, Md. Army Coating and Chemical Lab.
1964 DESERT TESTS: ALL WEATHER BRAKE FLUID Final Report
Charles B. Jordan 5 Apr. 1965 34 p refs
(CCL-179; AD-462061)

The object was to evaluate high temperature field performance of an improved all-weather hydraulic brake fluid. Results of desert tests conducted at Yuma Proving Ground, Arisona during the summer, 1964, are presented. New brake cylinders were packaged with the fluid and installed on 1/4-, 3/4-, 2 1/2- and 5-ton facility vehicles; the fluid was placed in the brake systems; the vehicles were then placed in normal facility operation during the test period. A control test was conducted simultaneously with vehicles containing a VV-H-910a brake fluid. The improved fluid performed satisfactorily in all vehicles. Author

N65-25208# Naval Ordnance Lab., White Oak, Md.
CHEMICAL AND PHYSICAL EFFECTS OF GLASS SURFACES UPON LAMINATING RESINS
P. W. Erickson, Angelo Volpe, and E. Ruth Cooper Apr. 1964 20 p
(NOLTR-63-267; AD-437170)

A new theory is discussed to explain another possible function of a finish at the resin–glass interface in a reinforced plastic. It is shown that glass surfaces with and without finishes display chromatographic properties. The data presented indicate that forces or factors at the interface lead to changes in the liquid resin-hardener ratio. The results are interpreted as evidence for the existence of a flexible resin layer at the interface, which operates to reduce local interlaminar stresses. Different glass fiber finishes are postulated to lead to different physical properties in this deformable resin layer which may have important effects on laminate strength properties. Author

N65-25273*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PROPERTIES OF TWO WHITE PAINTS FOR APPLICATION TO INFLATABLE SPACECRAFT: TITANIUM-DIOXIDE-PIGMENTED EPOXY AND ZINC-OXIDE-PIGMENTED METHYL SILICONE ELASTOMER
Charles V. Woerner Washington, NASA, Jun. 1965 23 p refs
(NASA-TN-D-2834) CFSTI: HC $1.00/MF $0.50

Two white paints prepared for application to inflatable space structures have been studied: a zinc-oxide-pigmented methyl silicone elastomer and a titanium-dioxide-pigmented epoxy. The data show that either coating can be used on an inflatable structure. The mechanical properties of the silicone paint and the white epoxy paint are excellent, even after cycling through a temperature range of 90° C to −196° C. The white epoxy paint is found not to be a stable paint for long duration exposure to ultraviolet radiation. The zinc-oxide-pigmented methyl silicone elastomer is reasonably stable under the influence of ultraviolet radiation with an increase of 6 to 15 percent of the initial value of solar absorptance when exposed to 1000 equivalent sun hours of simulated solar ultraviolet radiation. The solar absorptance of both paints is affected much less by electron radiation than by ultraviolet radiation for equivalent exposure times in space for an orbit comparable to that of the 12-foot-diameter sphere, Explorer XIX (1963 53A). Author

N65-25317# College of Aeronautics, Cranfield (England). Dept. of Materials
SOME ASPECTS OF THE THERMAL DEGRADATION OF EPOXIDE RESINS, PART I
J. M. Stuart and D. A. Smith Mar. 1965 32 p refs
(CoA-Note-Mat-7, Pt. 1)

A review of previous work in the field of pyrolytic degradation of epoxide resins, and a description of the development of an instrument for this purpose, using the principle of gas chromatography is presented. The method depends on the pyrolysis of the material using an electrically heated filament, the difficulties of this method are critically examined, and attempts to overcome them described. The pyrolytic degradation in a nitrogen atmosphere, of unhardened epoxide resin was investigated, likewise the degradation of resin hardened with 1:2 diamino ethane and triethylene–tetramine, is described. An attempt was made to explain, in terms of possible degradation reactions, the actual compounds detected in the pyrolytic breakdown. Author

N65-25353# Royal Aircraft Establishment, Farnborough (England).
DIMENSIONAL CHANGES OF SOME SAMPLES OF PHOTOGRAPHIC FILM
C. W. Husbands and D. J. Pyke London, Min. of Aviation, Apr. 1962 12 p refs
(RAE-TN-IR-2)

Changes in dimension, during 1 year, of samples of low shrink base photographic film kept under ordinary room conditions were studied. A contact print of a glass scale was made on the film samples and a microphotometer used for setting on the line marks and their images to obtain differences between the original and its reproduction on the film. No correlation was found between dimensional changes observed and ambient temperature and humidity. A conclusion is that, in making a measurement of a dimension on film, there is liable to be an unpredictable error of average value 1/20% in the value found on any one occasion. A further conclusion is that no effective allowance can be made for the effect of humidity or temperature. Author

N65-25371# General Electric Co., Philadelphia, Pa. Re-Entry Systems Dept.
EVALUATION OF GRAPHITE COMPOSITES IN RE-ENTRY ENVIRONMENTS Progress Report

E. J. Nolan and R. A. Tanzilli Aug. 1964 14 p
(Contract AF 33(615)-1768)
(PR-1; AD-460964)

Detailed program plans, budgets, and program objectives were formulated and design and fabrication of test specimens initiated. The most recent heat and mass transfer correlations developed by Scala and Gilbert for a blunted-conical body are utilized in the systems study. Author

N65-25399# Massachusetts Univ., Amherst. Polymer Research Inst.
A TECHNIQUE FOR THE STUDY OF SPHERULITE DEFORMATION LIGHT SCATTERING MOVIES
P. F. Erhardt and R. S. Stein 1 Dec. 1964 3 p ref
(Contract Nonr-3357(01))
(ONR-TR-77; AD-612489)

The use of a continuous wave gas laser, and of a high speed motion picture camera as the detector to obtain a nearly continuous set of light scattering photographs from a single polymer sample of polyethylene, is described. The stretching direction of the medium density polyethylene was along the long axis of the film strip and the polarization directions were perpendicular and parallel to the direction of stretch. Good scattering pictures were obtained at camera speeds as high as 5400 frames per second and the change in H_v scattering patterns on the stretched sample is illustrated. G.G.

N65-25415# Forest Products Lab., Madison, Wis.
EFFECT OF TENSILE MEAN STRESSES ON FATIGUE PROPERTIES OF PLASTIC LAMINATES REINFORCED WITH UNWOVEN GLASS FIBERS
Kenneth H. Boller Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1964 37 p refs
(Contract AF 33(657)-63-358)
(ML-TDR-64-86; AD-605412)

Fatigue curves are presented for plastic laminates reinforced with layers of unwoven E-glass filaments in a matrix of epoxy-type resin and subjected to various alternating stress amplitudes superimposed on constant mean tensile loads. The S-N curves were determined by axially loading specimens that had alternate layers of glass at 0°, ±5°, ±10°, and ±15° to the principal axis. Curves were also determined for three special constructions of unwoven glass laminates in which 71.4 percent of the fibers were parallel to the principal axis, 85.2 percent were parallel, and all layers were parallel with each layer supported by a carrier of 2-mil glass fabric. All experiments were conducted on unnotched specimens, at 900 cycles per minute, and in an atmosphere maintained at 73°F and 50-percent relative humidity. Loads were applied parallel to the principal axis. Author

N65-25417# National Bureau of Standards, Washington, D. C.
PROPERTIES OF GLASSES AT ELEVATED TEMPERATURES Technical Report, Jan.–Dec. 1964
M. J. Kerper, T. G. Scuderi, and E. H. Eimer Wright-Patterson AFB, Ohio, AF Mater. Lab., Mar. 1965 27 p refs
(Contract AF 33(657)62-362)
(WADC-TR-56-645, Pt. X; AD-463321)

A relationship between the modulus of rupture and the size of the mirror on the fracture face was established for thermally tempered and for annealed glass. This relationship appears to hold only for specimens whose fracture originated on the surface for semitempered and tempered specimens while it holds for specimens whose fracture originated on the edge as well as the surface for annealed glass. The Youngs modulus of two chemically strengthened glasses was determined as was the strength of these glasses over a broad temperature range. There was no loss in strength for short time (1/4 hour) exposures up to 500° F however, a definite time–temperature effect on strength is evident after longer exposure times. A defined delayed elastic effect was also encountered in these chemically strengthened glasses. Author

N65-25511# Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF THE COMPOSITION OF VOLATILE PRODUCTS RELEASED BY CERTAIN PLASTICS AFTER EXPOSURE TO HIGH TEMPERATURES
Ye. V. Deyanova et al 8 Jun. 1965 5 p Transl. into ENGLISH from Gigiena Truda i Prof. Zabolevaniya (Moscow), no. 7, Jul. 1964 p 57–58
(JPRS-30463; TT-65-31182) CFSTI: $1.00

The composition of volatile substances released by a plastic with polyvinyl chloride resin, and a rubber consisting of chlorosulfonated polyethylene, magnesium oxide, and other additives was investigated for the temperature zones of 70° to 100° and for 600° to 700° It was found, that at the lower temperature range a number of toxic substances were released into the air with large amounts of toxic substances constituting a health hazard. G.G.

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N65-24421# Michigan Univ., Ann Arbor. Dept. of Communication Sciences
TOWARD A HOMOLOGICAL ALGEBRA OF AUTOMATA III: 3. COMPOSITION SERIES OF AUTOMATA. 4. EXTENSIONS OF Q-AUTOMATA
Yehoshafat Give'on Dec. 1964 38 p refs
(Contract Nonr-1224(21); Grant DA-ARO(D)-31-124-G588)
(Rept.-06689,03105-31-T; AROD-4049-9; AD-610198)

The categorical theory of abstract automata is formulated. Two basic problems are posed. First, how restricted is the study of abstract automata when it is confined to those properties formulated by means of the category theory only? This is a mathematical question whose answer should be proved. The completeness of the categorical study of abstract automata is proved for a wide class of input monoids, a class which includes all types of monoids employed in the theory of finite automata. To get this result, a general representation theorem for abstract automata is derived. The second question is psychological. How well does the categorical study of automata suit intuitions and the problem? The answer to such a problem is not a matter of proof. The development presented shows the potentiality of this new approach toward automata. Author

N65-24422# Michigan Univ., Ann Arbor. Dept. of Communication Sciences
TOWARD A HOMOLOGICAL ALGEBRA OF AUTOMATA I: 1. THE REPRESENTATION AND COMPLETENESS THEOREM FOR CATEGORIES OF ABSTRACT AUTOMATA

Yehoshafat Give'on Dec. 1964 27 p refs For abstract see N65-24421 14-19
(Contract Nonr-1224(21); Grant DA-ARO(D)-31-124-G588)
(Rept.-006689, 03105-32-T; AROD-4049-8; AD-610200)

N65-24424# RAND Corp., Santa Monica, Calif.
ON THE THEORY OF RANDOM FUNCTIONS AND THE CONTROL OF PROCESSES ON THE BASIS OF INCOMPLETE DATA
A. N. Shiryaev Apr. 1965 42 p refs Transl. into ENGLISH from RUSSIAN
(Contract AF 49(638)-700; Proj. RAND)
(RM-4527-PR; AD-613974)

A theoretical study of problems in estimating a parameter which is subject to change as time progresses is presented. The estimation model represents a generalization of the classical approach, and it establishes the parameter as a Markov process with an associated random process consisting of a sequence of identically distributed independent random variables. Bayesian analysis of the model revealed that the a posteriori probability of the observations on the random process frequently plays the role of a sufficient static. A multidimensional analog of the Wald problem for testing two simple hypotheses is presented which involves sequential scanning of a number of channels with a single inspection device. The general solution employs certain recurrence relations for nonadditive functionals in which time is a discrete variable; limit forms of the solutions where time essentially becomes a continuous variable are given. J.M.D.

N65-24448# Wisconsin Univ., Madison. Mathematics Research Center
ON THE SIZE OF THE RIEMANN ZETA-FUNCTION AT PLACES SYMMETRIC WITH RESPECT TO THE POINT 1/2 Technical Summary Report
R. D. Dixon and Lowell Schoenfeld Nov. 1964 7 p refs
(Contract DA-11-022-ORD-2059)
(MRC-532; AD-613373)

A result of R. Spira's is improved and simplified. The form given of this result is that if $s = \sigma + it$ and ζ is the Riemann zeta-function, then $|\zeta(1 - s)| > |\zeta(s)|$ for all s other than zeros of ζ provided $|t| \geq 6.8$ and $\sigma > 1/2$. The proof uses Stirling's formula, as did Spira's, together with the fact that if f is an analytic function of s then

$$\partial/\partial\sigma \log|f(\sigma + it)| = R\, d/ds \log f(s).$$ Author

N65-24542 Joint Publications Research Service, Washington, D. C.
PERIODIC OSCILLATIONS OF QUASILINEAR SELF-CONTAINED DELAY SYSTEMS
K. M. Tsoy *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 205-218 refs (See N65-24525 14-07)
CFSTI: $7.00

The conditions for the existence of periodic solutions for quasi-linear self-contained systems with two degrees of freedom and with constant time delay are established for one particular class of self-contained systems in the case of multiple roots of the resolvent. To obtain these conditions, an auxiliary system for which a periodic solution always exists which is analytic with respect to μ is considered, together with the initial system. The practical method of the computations of the periodic solutions are indicated for the case of multiple roots. Author

N65-24704# Ballistic Systems Div., Norton AFB, Calif.
CERTAIN APPLICATIONS OF THE EXPONENTIAL DISTRIBUTION
J. P. Leary, Jr. 15 Jan. 1964 210 p refs
(Rept.-1920.64-454; AD-459736)

This monograph contains a number of detailed computational methods and associated tables for application of the exponential distribution to the analysis of test data, life testing, reliability estimation, etc. The data may fit different theoretical distributions and can be applied to various mathematical models. G.G.

N65-24705# Ballistic Systems Div., Norton AFB, Calif.
CERTAIN APPLICATIONS OF MATHEMATICS AND STATISTICS TO RELIABILITY AND AVAILABILITY
J. P. Leary, Jr. 20 Jan. 1964 191 p refs
(Rept.-1920.64-462; AD-459734)

Applications of probability distributions to problems in reliability and availability are presented. For electrical systems and components models are proposed for sampling parts, life testing, evaluating failure rates and distributions, setting confidence limits for acceptance procedures; the models are variously based on discrete distributions, the negative binomial, normal, poisson, gamma, and rectangular probability densities. Particular interest is in maintenance requirements with respect to spare parts for established systems, repairmen, and minimization of costs. Operating characteristic curves for life testing plans for the normal and lognormal distributions, and tables of probabilities of survival of redundant elements, are included. J.M.D.

N65-24770# European Atomic Energy Community, Brussels (Belgium).
CALCUALTION OF BESSEL FUNCTIONS I_n BY MEANS OF CONTINUED FRACTIONS [CALCUL DES FONCTIONS DE BESSEL I_n MOYENNANT LES FRACTIONS CONTINUES]
R.-F. Gloden Feb. 1965 15 p refs In FRENCH; ENGLISH Summary
(EUR-2163.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186; 40 Belg. Fr.

It is known that the quotient of two Bessel functions $I_n(x)$ of consecutive indices, can be represented, except for a factor which is the product of a constant times a power of the variable x, by a quotient of two hypergeometric functions of type ${}_0F_2$. This quotient is equal to a continued fraction. Knowing $I_0(x)$ in a given interval, one can compute $I_n(x)$, $n = 1, 2, 3, \ldots$, successively at any point of this interval, without using the recurrence formula. An error bound is known if the nth approximating fraction is substituted for the continued fraction, which converges for any x. The convergence is too slow for large values of the variable. Subroutines were established, some in FAP, that allow Bessel functions I_n, $n = 1, 2, \ldots, 10$, for $0 \leq x \leq 10$. The precision of $I_n(x)$ is of the order of 10^{-2} for $x < 8$; the precision of $e^{-x}In(x)$ is of the same order for $8 \pm x \pm 10$. Author

N65-24924*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics
SUPERPOSITION IN A CLASS OF NONLINEAR SYSTEMS
Alan V. Oppenheim (Ph.D. Thesis) 31 Mar. 1965 66 p refs *Its* Tech. Rept. 432
(Grants NsG-496; NIH-MH-04737-04; NSF GP-2495; Contract DA-36-039-AMC-03200(E))
(NASA-CR-63063) CFSTI: HC $3.00/MF $0.75

Many nonlinear systems can be interpreted as linear transformations between vector spaces under appropriate definitions

for the vector operations on the inputs and outputs. The class of systems which can be represented in this way is discussed. This class—the class of homomorphic systems—is shown to include all invertible systems. Necessary and sufficient conditions on a noninvertible system such that it is a homomorphic system, are derived. A canonic representation of homomorphic systems presented consists of a cascade of three systems, the first and last of which are determined only by the vector space of inputs and the vector space of outputs, respectively. The second system in the canonic representation is a linear system. Necessary and sufficient conditions are presented under which all memory in the system can be concentrated in the linear portion of the canonic representation. A means for classifying homomorphic systems, suggested by the canonic representation. Applications of the theory are considered for a class of nonlinear feedback systems. Author

N65-25118 Joint Publications Research Service, Washington, D. C.
ON THE OPIAL INEQUALITY
Lo-keng Hua *In its* Transl. on Communist China's Sci. and Technol., No. 179 17 May 1965 p 50–51 refs Transl. into ENGLISH from K'o-hsueh T'ung-pao (Peking), no. 3, 17 Mar. 1965 p 251 (See N65-25114 14-34) CFSTI: $4.00

A new proof is presented for the Opial inequality for a function y(x) which is absolutely continuous in (0, a):

$$\int_0^a |y(x)y'(x)|\,dx \leq \frac{1}{2}\,a\int_0^a [y'(x)]^2\,dx$$

Here, it is assumed that y(0) = 0.0 that the equal sign is taken only when y = bx, and y'(x) is the derivative of y(x). The inequality is derived from the Schwartz inequality in the proof presented. E.E.B.

N65-25257# Stanford Univ., Calif. Computer Science Dept.
MAXIMIZING A SECOND-DEGREE POLYNOMIAL ON THE UNIT SPHERE
George E. Forsythe and Gene H. Golub 5 Feb. 1965 33 p refs
(Contract Nonr-225(37))
(CS16; AD-611427)

Let A be a hermitian matrix of order n, and b a known vector in C^n. The problem is to determine which vectors make $\Phi(x) = (x-b)^H A(x-b)$ a maximum or minimum on the unit sphere $U = \{x : x^H x = 1\}$. The problem is reduced to the determination of a finite point set, the spectrum of (A,b). The theory reduces to the usual theory of hermitian forms when b = 0. Author

N65-25259# Massachusetts Inst. of Tech., Cambridge. Operations Research Center
FUNDAMENTAL INVESTIGATIONS IN METHODS OF OPERATIONS RESEARCH; THE STOCHASTIC BEHAVIOR OF TRAFFIC ON A TWO-LANE ROAD
Pieter Jacob Weeda Nov. 1964 53 p refs
(Contract DA-31-124-ARO(D)-209)
(TR-9; AD-609958)

Cars are divided into a finite number of discrete free speed classes. A car is moving on its free speed, when it is free from interaction with other cars. For the remaining part of its travel time it is driving on the speed forced upon it by the leaders of queues with slower free speed. The queues, that build up among the cars, that successively pass slow-moving cars, are approximated by steady-state queues. A set of equations is established relating the mean number of cars per mile of each free speed class and the mean number of queue leaders per mile of each class. These equations contain implicitly the relation between the free speed distribution of cars on the road and the speed distribution of leaders. For four different free speed distributions and for different values of the total density of the traffic stream, the distributions obtained are the speed distribution of leaders, the instantaneous speed distribution of cars passing a fixed point on the road and the distribution of speeds of a single car with given free speed during its travel time on the road. Basically, this method can be used for any model representing individual queues and any number of free speed classes. However, the complicated algebra restricts the number of free speed classes used. For this reason, a relatively simple queueing model is chosen. Results are obtained for three- and five-speed classes. Author

N65-25280# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
DISTRIBUTIONAL BOUNDARY VALUES OF FUNCTIONS HOLOMORPHIC IN A HALF PLANE
E. J. Beltrami and M. R. Wohlers Dec. 1964 17 p refs
(RM-255J)

Boundary values of a class of functions which are holomorphic and of algebraic growth at infinity are considered. For the class H^+ of functions written as $F(p) = F(\sigma + i\omega)$, which are holomorphic in the half plane Re $p>0$ and bounded by a polynomial uniformly in the every half plane Re $p \geq \sigma > 0$, alternative necessary and sufficient conditions are presented for convergence to tempered distributions. One such condition is that the tempered distribution should be the Fourier transform of a tempered distribution which has its support in the positive half axis, and whose Laplace transform is the function in H^+. By specializing the tempered distributions to the case where the boundary values can be written as finite sums of finite derivatives, the above theorem reduces to the guarantee of the existence of Hilbert transform pairs on the boundary. The theorem is also used to show that the class of functions which are bounded and holomorphic in the right half plane is completely characterized by knowledge of its distributional boundary values. J.M.D.

N65-25281# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
TABLES FOR CONVERTING 2θ TO Q. PART V: Q VS 2θ IN INTERVALS OF 0.1° 2θ 0 < 2θ < 180° FOR COPPER Kα_1 RADIATION
Daniel Rodier and Richard C. Carlston Dec. 1964 6 p ref
(RM-256)

N65-25282# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
TABLES FOR CONVERTING 2θ TO Q. PART VI: Q VS 2θ IN INTERVALS OF 0.01° 2θ 0< 2θ <180° FOR COPPER K α_1 RADIATION
Daniel Rodier and Richard C. Carlston Dec. 1964 33 p ref
(RM-257)

N65-25306# European Organization for Nuclear Research, Geneva (Switzerland). Data Handling Div.
A SHORT TABLE OF A DEFINITE INTEGRAL INVOLVING A PRODUCT OF BESSEL FUNCTIONS
K. S. Kölbig 3 May 1965 33 p refs
(CERN-65-16)

Some properties of

$$F(t,u) = \int_0^1 J_1(t\rho)J_0(u\rho)d\rho$$

are described, and a table for $F(j_{n,m}u)$ with n = 0,1,2; m = 1(1)5 and u = 0(0.1)20 is given. Author

N65-25337# Copenhagen Univ. (Denmark). Inst. of Mathematical Statistics
SUPPLEMENTARY AQL SINGLE SAMPLING INSPECTION PLANS
A. Hald Feb. 1965 11 p
(Contract N62558-3073)
(AD-611760)

In a previous paper a set of AQL single sampling inspection plans was given for $\gamma = 2$ and 10. Further research along the same lines led to a generalized model and corresponding tables as given previously. One of the new results is that values of γ may normally be expected to be less than 2. For completeness this paper contains a set of AQL plans for $\gamma = 0.2$ and 1.0 defined and computed as described previously. TAB

N65-25347*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AUXILIARY ESTIMATING FUNCTIONS FOR DOUBLY TRUNCATED NORMAL SAMPLES
J. David Lifsey 21 May 1965 52 p refs
(NASA-TM-X-53221) CFSTI: HC $3.00/MF $0.50

When a sample of a random variable X results in N measured observations for which $X_\alpha < X < X_\beta$, with no information known about $X < X_\alpha$ or $X > X_\beta$, the sample is described as being doubly truncated at the points X_α and X_β. To calculate maximum likelihood estimates for the mean and standard deviation of a normally distributed population from doubly truncated normal samples, it is necessary to solve simultaneously a pair of rather complex nonlinear estimating equations. In 1957, Cohen gave methods employing a graph of estimating curves for reducing the computational labor required to obtain these solutions. A graph is given and auxiliary functions are evaluated to further aid in obtaining solutions to the estimating equations. The asymptotic (large sample) variances and covariance of these estimates are also evaluated. Author

N65-25391# California Univ., Berkeley. Operations Research Center
PEAKEDNESS OF DISTRIBUTIONS OF CONVEX COMBINATIONS
Frank Proschan Oct. 1964 13 p refs
(Contract Nonr-3656(18))
(ORC-64-26(RR); AD-612967)

The probability of a given size deviation decreasing monotonically as the sample size n of a random sample increases is investigated. Under appropriate conditions the peakedness of the distribution of the average of n increases with n. Peakedness is defined as: X_1 is more peaked about a_1 than X_2 about a_2 if

$$P[|X_1 - a_1| \geq t] \leq P[|X_2 - a_2| \geq t$$

for all $t \geq 0$, where X_1 and X_2 are the real random variables and a_1 and a_2 the real constants. In the case $a_1 = 0 = a_2$, X_1 is more peaked than X_2. Stochastic comparisons between the averages of 2^n and 2^{n+1} variables, $n = 1, 2, \ldots$ can be obtained with the use of Birnbaum's lemma. G.G.

N65-25392# California Univ., Berkeley. Operations Research Center
NOTES ON OPERATIONS RESEARCH—4
Nov. 1964 71 p refs
(Contract Nonr-222(83); Grant NSF GP-2633)
(ORC-64-30; AD-612966)

Articles on *Statistical Inference in Markov–Renewal Processes; A Note on Deficit, Excess, and Spread in a Markov–Renewal Process;* and *Near-Parallel Constrained Objectives in Integer Programs* are presented. Also, reviews on *Programing under Nonlinear Constraints by Unconstrained Minimization: A Primal–Dual Method; Application of the PERT Method and Its Varients to Programs of Production and Planning; Scheduling Problems—Applications and Methods;* and *Scientific Decision Making in Business: Readings in Operations Research for Nonmathematicians* are included. Further, selected abstracts in operations research are given. E.E.B.

N65-25470# Joint Publications Research Service, Washington, D. C.
ABSTRACTS ON PROBABILITY THEORY AND MATHEMATICAL STATISTICS AND COMPUTER ENGINEERING FROM REFERATIVNYY ZHURNAL—KIBERNETIKA (SOVIET ABSTRACTS JOURNAL—CYBERNETICS), NO. 12, 1964
11 Jun. 1965 399 p refs Transl. into ENGLISH from Referat. Zhur., Kibernetika (Moscow), no. 12, 1964
(JPRS-30573; TT-65-31247) CFSTI: $7.00

Universal decimal classification number, original language, language of resume, source, author, Russian abstract number, and name or initials of the abstractor are included. Abstracts are presented on probability theory; mathemetical statistics; and uses of probability theory and statistical methods. Relative to computer engineering abstracts are presented on the theory of computing devices and machines; continuous-action (analog) mathematical devices and machines; discrete-action (digital) devices and machines; and uses of computing machines and devices. N.E.A.

N65-25536# RAND Corp., Santa Monica, Calif.
ON THE THEORY OF RANDOM FUNCTIONS AND THE CONTROL OF PROCESSES ON THE BASIS OF INCOMPLETE DATA
A. N. Shiryaev Apr. 1965 42 p refs Transl. into ENGLISH from Russian
(Contract AF 49(638)-700; Proj. RAND)
(RM-4527-PR; AD-613974)

The topics covered include (1) recurrence relations for nonadditive functional—discrete time, (2) determination of optimal decisions, and (3) the detection of a change in the probability law of the observed process. TAB

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N65-24473# Naval Weapons Lab., Dahlgren, Va. Computation and Analysis Lab.
RECENT TRENDS IN METEOROLOGICAL LITERATURE AND THEIR RELATION TO NAVAL WEAPONS SYSTEMS
Robert M. Fenn and Dayton G. Vincent Dec. 1964 89 p refs
(K-61/64; AD-609968)

Meteorological literature published during the years 1954–1964 is surveyed, some of the changes are described which have occurred in the science of meteorology concurrently

with, and in some cases, as a direct result of, new developments in naval weapons. The influence of new concepts in military weapons systems is shown by the rapid increase in the number of publications related to meteorology and its effect on weapons or, as defined here, "ballistic meteorology." An example of the increasing importance of meteorology in the design, testing, and operational use of naval weapons is given in the section on "Meteorological Support for Polaris." The bibliography, containing over 700 titles on ballistic and general meteorology, is appended. Author

N65-24523*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE INTERPRETATION OF TIROS RADIATION DATA FOR PRACTICAL USE IN SYNOPTIC WEATHER ANALYSIS
Lewis J. Allison and Guenter Warnecke Washington, NASA, Jun. 1965 32 p refs
(NASA-TN-D-2851) CFSTI: $2.00/MF $0.50

Radiation data in the 8μ to 12μ atmospheric window and 6μ to 6.5μ water-vapor absorption region, acquired from the TIROS III meteorological satellite demonstrate applications of satellite radiation data in synoptic weather analysis. Applications include mapping horizontal cloud patterns at three different scales from meso- to quasi-global, derivation of mean relative humidities in the troposphere over the United States, and inference of vertical cloud structure along a cross section extending from Jamaica to British Columbia. Each application is discussed in the light of corresponding conventional surface, upper air, vertical motion, relative humidity, precipitation, and cloud-cover charts. Also, satellite television pictures are used in the discussion of meso- and macroscale cloud mapping. Good synoptic correspondence is found between conventional data and television pictures and radiation data. Plausible mechanisms explain apparent discrepancies between the satellite and conventional data. Author

N65-24583# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
A COMPILATION OF SOLAR DATA FOR WHITE SANDS MISSILE RANGE
Paul H. Taft Ft. Monmouth, N. J., Army Electron. Command, Mar. 1965 19 p ref
(ERDA-305; AD-462057)

Tables and graphs are presented, with explanatory text, giving times of sunrise and sunset, duration of daylight, twilight and darkness, solar altitudes and azimuths, the earth's shadow height, and related data. Author

N65-24584# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
A COMPARISON OF TOWER AND PIBAL WIND MEASUREMENTS
Laurence J. Rider and Manuel Armendariz Ft. Monmouth, N. J., Army Electron. Command, Apr. 1965 22 p refs
(ERDA-304; AD-462056)

An empirical study of the time and space variability of the wind as measured by a tower-mounted wind instrument and triple-theodolite pilot-balloon observations at Green River, Utah, during June and July 1964 is presented. Simultaneous wind measurements at 500 feet above ground are compared. Mean difference in wind direction was 15.0° with a sample standard deviation of 12.2°. Mean speed difference was 6.2 ft/sec with a sample standard deviation of 5.5 ft/sec. Author

N65-24638# National Science Foundation, Washington, D. C.
WEATHER MODIFICATION Sixth Annual Report, Period Ending 30 Jun. 1964
[1965] 72 p refs
(NSF-65-9)

Divergent views are discussed on the ability to alter the weather and the climate in which men live, to diminish the incidence of violent storms, and to change large scale air circulations in ways that will bring precipitation to areas that are now semiarid or desert. The weather modification programs of the various U.S. Government agencies are outlined, and field investigations as well as laboratory studies are presented. G.G.

N65-24784# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
ATHENA FLIGHT NUMBER 009, VEHICLE C-006 (15 JANUARY 1965) Meteorological Data Report
Gordon L. Dunaway and Harris Karns, III Feb. 1965 59 p refs
(ERDA-265; AD-461574)

Meteorological data gathered for the launching of Athena Flight Number 009, Vehicle #C-006, are presented for ballistic studies. The data are presented in tabular form. Author

N65-24825# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
AEROBEE NE 3.156 (S/N NRL 93), 20 APRIL 1965 Meteorological Data Report
Majorie Mc Lardie Hoidale May 1965 36 p refs
(ERDA-311; AD-462451)

Meteorological data gathered for the launching of Aerobee NE 3.156 (S/N NRL 93) are presented for ballistic studies. Calculated ballistic data are included. Author

N65-24883 Joint Publications Research Service, Washington, D. C.
METEOROLOGICAL CHANGES PAST AND PRESENT
Hsu Ch'un *In its* Transl. on Communist China's Sci. and Technol., No. 181 25 May 1965 p 21-27 Transl. into ENGLISH from K'o-hsueh Ta-chung (China), no. 3, Mar. 1965 p 28-30 (See N65-24879 14-34) CFSTI: $3.00

Long-range meteorological changes throughout the world are analyzed, with emphasis on China. Average annual temperatures between years 1811 and 1960 are plotted by decades for weather stations in North America, Soviet Union, Argentina, and China, which shows temperature rising stably in the last 100 years; at all stations the mean temperatures are 1° C higher than the corresponding times in the last century. Increasing warmth at the North Pole has caused elevation in ocean surfaces of about 1.2 cm every year, while the water level of many inland lakes and rivers is dropping in the medium latitude regions. Temperature trends since the sixth century, and meteorological patterns in the present century, are outlined for China. J.M.D.

N65-25201# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
UPPER STRATOSPHERIC CIRCULATION OVER ASCENSION ISLAND
Bruce T. Miers Apr. 1965 14 p refs
(ERDA-303; AD-462055)

Nine years of radiosonde data and twenty-six months of meteorological rocket data over Ascension Island indicate a

26-month cycle in the winds near 35 km. The 26-month cycle attained its maximum amplitude in the 22- to 25-km region, and was obscured at higher altitudes by the annual and semi-annual cycles. During January, February, and March, southeasterly winds were observed at 45 km, and it is believed that summer easterlies extend into the winter hemisphere and disrupt the winter westerlies. This intrusion of summer easterlies into the winter hemisphere could initiate sudden warmings. Author

N65-25209# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
AEROBEE NB 3.176 (S/N NRL 91-3) Meteorological Data Report, 26 Apr. 1965
Marjorie Mc Lardie Hoidale May 1965 43 p refs
(ERDA-316; AD-463475)

Meteorological data gathered for the launching of Aerobee NB 3.176 (S/N NRL 91-3) are presented for ballistic studies. Calculated ballistic data are included. Author

N65-25210# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
AEROBEE NF 3.162R (S/N NRL 95-3) Meteorological Data Report, 4 May 1965
Marjorie Mc Lardie Hoidale May 1965 34 p refs
(ERDA-318; AD-463421)

Meteorological data gathered for the launching of Aerobee NF 3.162R (S/N NRL 95-3) are presented for ballistic studies. Calculated ballistic data are included. Author

N65-25423# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AN AUTHOR BIBLIOGRAPHY: NOCTILUCENT AND NACREOUS CLOUDS, CIRRIFORM CLOUDS, CONDENSATION TRAILS
Majorie Mc Lardie Hoidale Aug. 1964 97 p refs
(ERDA-181; AD-446672)

N65-25530 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CLIMATE OF THE USSR. ISSUE 8: CLIMATE OF THE FREE ATMOSPHERE
N. F. Nakorenko and F. G. Tokar 9 Feb. 1965 267 p refs Transl. into ENGLISH of "Klimat USSR. Vypusk 8: Klimat Svobodnoy Atmosfery" Leningrad, Gidrometeorol. Izd., 1959 p 1–220
(FTD-MT-63-339; AD-613988)

The monographs illustrate the climate of the free atmosphere above the U.S.S.R. to a height of 15 km over 5 consolidated regions. The peculiarity of distribution of main meteorological elements at their potential heights are revealed. Characteristics are presented of cloudiness, and the conditions favoring icing. The monograph is designed to satisfy the demands of aviation, and to use in synoptic practice. It can be applied as a training aid by students of universities and special secondary educational institutions. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N65-24760# , Royal Aircraft Establishment, Farnborough (England).
METHODS OF BAROMETRIC HEIGHT MEASUREMENT [ZUR SYSTEMATIK DER BAROMETRISCHEN HOHENMESSUNG]
E. Rossger and G. Ranike Jan. 1965 45 p refs Transl. into ENGLISH from Z. Flugwiss. (Brunswick, W. Germany), v. 11, 1963 p 322–339
(RAE-LIB-TRANS-1090)

This investigation deals with the meteorological principles of vertical navigation based on measurements of pressure, and with the use of an altimeter, the main scale of which is calibrated in units of altitude. Included is a description of several altimeters of this type, and a discussion of navigational consequences arising from their application. The meteorological principles of altimeters having the main scale calibrated in units of pressure are cited and the features of some of these altimeters examined. Hybrid altimeters are also considered. Author

N65-25250# Boeing Co., Seattle, Wash.
AN INTRODUCTION TO THE LINEARIZED THEORY OF SPACE CRAFT GUIDANCE EVALUATION
Arthur R. Dusto [1964] 79 p refs
(D2-90596)

The theory considered is that necessary to evaluate guidance requirements for a vehicle which is launched into a trajectory by a booster whose operation contains errors, which has its actual trajectory determined from measuring instruments which have operating errors, and which is controlled by a system which also has operating errors. Linearization of the theory is achieved by assuming the actual trajectory of the vehicle deviates only slightly from a known nominal trajectory. State of the vehicle is described in terms of six small quantities called the deviation in state variables and represented by components of the vector $\delta\underline{X}$. Control is taken to be an impulsive velocity change $\underline{Vg}$ calculated from the deviated state at time of control by the linear relation $\underline{Vg} = (G,H)\delta\underline{X}$. Guidance matrices G and H are determined by requiring satisfaction of specified terminal conditions with constraints on $\underline{Vg}$ such as that its magnitude be a minimum. Linear theory of trajectory determination from various types of navigation measurements containing random and bias errors is developed for single- and multiple-stage estimation procedures. Statistical techniques for trajectory determination procedures are described. Random and bias error sources are considered. Random error sources are assumed Gaussian; bias errors, small. The results give first order approximation of the probable full requirements for control and the probability that the objectives of a mission are achieved. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N65-24390# General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
REACTOR INSTRUMENTATION RESPONSE TO IN-CORE VOID FORMATION Technical Report, 1 Oct. 1963–30 Sep. 1964

E. L. Jordan Kirtland AFB, N. Mex., AF Weapons Lab., Mar. 1965 28 p refs
(Contract AF 29(601)-6213)
(FZK-215; AFWL-TR-64-145; AD-614037)

The response of reactor instrumentation to in-core void formations that simulate nucleate and partial-film boiling was studied in the Reactivity Test Assembly. The voids were generated by bubbling air through the desired element position. The experiments were performed with core configurations representing the ground test reactor and the aerospace systems test reactor. The void coefficient of reactivity and the instrumentation response were measured for void fractions of up to 0.15 $\Delta V/V$. Simulated boiling was not detected by observation of the normal reactor instrumentation, but amplification and bandpass filtering permitted detection for single-element void volumes greater than 0.05 $\Delta V/V$. Author

N65-24460# California Univ., Livermore. Lawrence Radiation Lab.
STABILITY OF CRACKED TUBES AT ELEVATED TEMPERATURE AND HIGH FLOW RATE
E. Robinson and W. Wells 10 Apr. 1965 12 p
(Contract W-7405-ENG-48)
(UCRL-7369, Suppl. 1)

The effects produced in an array of ceramic hexagonal tubes by having the tubes severely cracked were studied. The test facility was a propane-fuel burner. Two sequences of tests were performed. The first were shakedown tests using steatite ($MgO–SiO_2$) tubes which were not precracked. These tests were limited to 1500° F with flow rates generally around 4 pounds/sec. The second test sequence was with precracked alumina tubes and incorporated various modifications suggested by the shakedown tests. The results show that severely precracked tubes successfully withstood radial temperature gradients of at least 100° F, and flow rates of 0.1 pound/sec per tube without fragmentation or collapse. It is further believed that there was no significant effect on the integrity of the flow passages insofar as it would affect convective heat transfer. In all essential respects the tubes survived the shakedown tests in good order. N.E.A.

N65-24571*# Northrop Space Labs., Huntsville, Ala.
APOLLO EXTENSION SYSTEM STUDIES. STATE OF THE ART OF RADIOISOTOPE POWER SYSTEMS FOR LUNAR SURFACE VEHICLES
W. L. Breazeale 6 May 1965 23 p refs
(Contract NAS8-11096)
(NASA-CR-61055) CFSTI: HC $1.00/MF $0.50

The development status of six radioisotope electric power systems suitable for operation on the lunar surface is investigated and discussed. The systems considered are a thermoelectric system, a thermionic system, a Brayton cycle system, a Mercury Rankine system, a Dowtherm-A Rankine System, and a Stirling engine. Applicability of these power systems to various lunar exploration concepts is discussed. All the systems investigated are sufficiently advanced in technology to permit delivery of flight-rated systems within four years. Hence these systems can be made available within the time frame planned for early lunar surface exploration. Information on isotope fuel forms was lacking, and recommendations are made to investigate this area. Author

N65-24730# Phillips Petroleum Co., Idaho Falls, Idaho.
SPERT PROJECT Quarterly Technical Report, Oct.–Dec. 1964
J. G. Crocker, ed., F. Schroeder, and W. E. Nyer Apr. 1965 43 p refs
(Contract AT(10-1)-205)
(IDO-17084) CFSTI: $2.00

A chronological summary of the tests which were performed with the various cores in Spert I is given. The experimental program with the Spert III plate-type core has been completed and did not show any damage to the core. Flow measurements with the fuel assembly of a low-enrichment oxide core in a Spert III facility showed a pressure loss of 44 psi at room temperature and a flow rate of 316 gpm. Preparations for nuclear operation of the capsule driver core in a Spert IV facility are almost completed and a program to determine a suitable capsule design by both calculations and out-of-pile experiments has been initiated. Hydrophanes, foils, semiconductors, and weldable strain gages gave reasonably accurate internal pressure measurements of generated pressures inside aluminum capsules during explosive testing. Exposure of a PBF prototype fuel rod to peak transient energy densities of 260 cal/g and also 210 cal/g in the Treat reactor facility indicated no clad growth. Out-of-pile tests of 60 and 70 vol% urania mixtures diluted with calcia-stabilized zirconia established a phase stability sufficient to permit their use in the PBF. G.G.

N65-24763# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
WORK METHODS FOR THE POST-IRRADIATION EXAMINATION OF EXPERIMENTAL FUEL ELEMENTS Paper No. 51
A. S. Bain, R. D. Mac Donald, D. B. Kerr, J. R. Kelm, and R. J. Cheiner Mar. 1965 14 p refs Presented at the ENEA Intern. Symp. on Working Methods in High Activity Hot Labs., Grenoble, France, Jun. 1965
(AECL-2226) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

Two high density concrete hot cells and a line of seven lead-shielded dry boxes are used for examination of irradiated fuel specimens, both metal and ceramic. Transfer techniques and working methods for a typical examination are described. Author

N65-24769# European Atomic Energy Community, Brussels (Belgium).
STUDY OF THE OPTIMUM ZONE OF THE INDEPENDENT VARIABLES OF AN ORGEL-REACTOR CONNECTED TO A 250 MWeb POWER PLANT—SLIGHTLY-ENRICHED NATURAL URANIUM CARBIDE FUEL ELEMENTS–BUNDLE OF 7 RODS, SAP CLADDING [ETUDE DE LA ZONE OPTIMALE DES PARAMETRES INDEPENDANTS D'UN REACTEUR ORGEL ASSOCIE A UNE CENTRALE DE 250 MWeb—ELEMENTS COMBUSTIBLES EN CARBURE D'URANIUM NATUREL LEGEREMENT ENRICHI–GRAPPE A 7 CRAYONS, GAINAGE EN SAP]
B. Haijtink, F. Lafontaine, and P. Tauch Feb. 1965 31 p refs In FRENCH; ENGLISH summary
(EUR-2116.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 50 Belg. Fr.

The object is the description of the optimum zone of the independent variables of an ORGEL-reactor connected to a 250-MWeb powerplant. These independent variables determine the geometry of the fuel elements (7 rods type UC, SAP clad), the geometry of the core and the operating conditions of the plant. A slight enrichment raises the economic interest of an ORGEL-type powerplant. Compared to a natural uranium-fueled ORGEL plant, such a conceptional modification decreases the specific investment in D_2O by 50%, whereas the burnup of the fuel elements is doubled. Hence the energy extracted per gram of fissile material doubles; the fuel depletion, and the plutonium

production in the irradiated fuel elements are increased. Such a modification of the fuel material conception permits a gain in the order of 0.8 mills/kWh in the cost of energy production. Author

N65-24771# Reactor Centrum Nederland, The Hague.
THE INFLUENCE OF LOCAL ABSENCE OF COOLING ON THE FUEL CLADDING TEMPERATURE
C. M. Kalker Feb. 1965 17 p ref
(Contract EURATOM-007-61-6-PNIN)
(EUR-2182.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

The temperature rise at the position of support of the fuel rods, which results from the local absence of cooling, is calculated. The support of the fuel rod is represented by a small circle, lying on the outer surface of the cladding, which simulates the contact area between fuel rod and supporting grid. The temperature rise is considered as a perturbation term superimposed on the undisturbed temperature distribution. Two extreme cases are considered, namely complete isolation of the perturbation term and complete cooling of the perturbation term outside the small circle. To compare with experimental results, the same calculations are applied to a case of heat production in a steel tube which is heated electrically. Author

N65-24871# European Space Vehicle Launcher Development Organization, Paris (France).
CHARACTERISTICS OF SOME RADIO-ISOTOPES SUITABLE FOR USE ON SPACE MISSIONS
J. P. Contzen Dec. 1964 13 p refs
(ELDO-TM/F/12)

The main characteristics of radioisotopes which could be used in space, either for propulsion or as auxiliary power sources, are given in tabular form. The nuclear, physical, and thermal properties of pure radioisotopes and their more common compounds are examined; annual production capacities and the prices of these isotopes are also given. Author

N65-24900# Atomic Energy Commission, Washington, D. C.
FAST REACTOR CONTROL MECHANISMS
C. J. Heltemes, Jr., ed. [1964] 196 p Proc. of the meeting held at AEC, Germantown, Md., 16–17 Sep. 1964
(WASH-1054, Pt. 1) CFSTI: $5.00

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5. SEFOR CONTROL DRIVE SYSTEM S. Stewart and W. Zschaler (GE) p 87–102 (See N65-24905 14-22)
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7. DESIGN, TEST AND PERFORMANCE OF THE CONTROL ROD DRIVES FOR THE ENRICO FERMI REACTOR J. G. Duffy, J. W. Hess, M. E. Leibson, and J. Matte, III (Atomic Power Develop. Assoc., Inc.) p 125–191 (See N65-24907 14-22)

N65-24901 Argonne National Lab., Ill.
REVIEW OF FAST REACTOR CONTROL FUNDAMENTALS
R. R. Smith *In* AEC, Washington Fast Reactor Control Mech. [1964] p 1–14 (See N65-24900 14-22) CFSTI: $5.00

The principles for fast reactor control mechanisms are reviewed. The supersafe philosophy of reactor control is discussed in relation to public acceptance to insure progress in reactor programs. The states of art for thermal and fast control systems are compared. Although thermal control systems were developed first and are therefore more advanced, much of their technology can be applied to fast control systems. A reactor is made critical by balancing neutron production, leakage, and parasitic absorption. Thus reactor control can be accomplished by moving fuel, reflector, or absorbing materials. The control systems used by various reactors, and factors such as core volume and fuel concentration which affect the choice of control, are discussed. R.N.A.

N65-24902 Argonne National Lab., Ill.
CONTROL DRIVE MECHANISMS FOR THE EBR-1 REACTOR
B. C. Cerutti *In* AEC, Washington Fast Reactor Control Mech. [1964] p 15–34 (See N65-24900 14-22) CFSTI: $5.00

Mechanical designs of reactor safety control drive mechanisms for the Experimental Breeder Reactor-1 are described. The sequence of operations involving these mechanisms for reactor startup is outlined. Dual-purpose drive mechanisms provide more control versatility, more shutdown worth, are more efficient, and are less costly to maintain than separate-control drive mechanisms. Schematic drawings of the reactor configuration, core, controls, hydraulic system, safety plug, and drive mechanisms are included. R.N.A.

N65-24903 Argonne National Lab., Ill.
EBR-II CONTROL DRIVES
E. Hutter *In* AEC, Washington Fast Reactor Control Mech. [1964] p 35–70 (See N65-24900 14-22) CFSTI: $5.00

The mechanical design of the Experimental Breeder Reactor-II safety control rod drives is described. Design criteria, major features, and operating characteristics are summarized. Preinstallation testing of the components and assembled drive mechanism performance during dry and wet critical experiments was satisfactory. Schematic drawings of various assembly stages are included. R.N.A.

N65-24904 Argonne National Lab., Ill.
FARET CONTROL DRIVES
E. Hutter *In* AEC, Washington Fast Reactor Control Mech. [1964] p 71–86 (See N65-24900 14-22) CFSTI: $5.00

The development of control rod drives for the Fast Reactor Test Facility is described. Design criteria and operating characteristics are summarized. Progress on the various control drive component testing programs is reported. Schematic drawings of the reaction cell complex and control drive are included. R.N.A.

N65-24905 General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
SEFOR CONTROL DRIVE SYSTEM
S. Stewart and William Zschaler *In* AEC, Washington Fast Reactor Control Mech. [1964] p 87–102 (See N65-24900 14-22) CFSTI: $5.00

The control rod drive system for the Southwest Experimental Fast Oxide Reactor is described. Design criteria and operating characteristics are outlined. Schematic drawings of

the reactor building, drive assembly, control rod and guide assembly, fine control drive, and hydraulic control system are included. R.N.A.

N65-24906 Los Alamos Scientific Lab., N. Mex.
CONTROL ELEMENT DRIVE MECHANISMS FOR LAMPRE I
R. E. Peterson *In* AEC, Washington Fast Reactor Control Mech. [1964] p 103–124 (See N65-24900 14-22) CFSTI: $5.00

The hydraulically powered reactor control rod drive systems for the LAMPRE I are described. The control elements, mechanical and hydraulic parts, hydraulic circuits, and electrical system are discussed. The control drive system performed satisfactorily during 2 1/2-year period of continuous operation. Photos and schematic drawings are included. R.N.A.

N65-24907 Atomic Power Development Associates, Inc., Detroit, Mich.
DESIGN, TEST AND PERFORMANCE OF THE CONTROL ROD DRIVES FOR THE ENRICO FERMI REACTOR
J. G. Duffy, J. W. Hess, M. E. Leibson, and J. Matte, III *In* AEC, Washington Fast Reactor Control Mech. [1964] p 125–191 (See N65-24900 14-22) CFSTI: $5.00

The operating control rod and safety rod drive mechanisms of the Enrico Fermi reactor are described. The function, operating characteristics, design criteria, and specifications are presented. The drive mechanism materials and design stresses are discussed. Performance during extensive nonnuclear testing was satisfactory. A preoperational and installation testing program is outlined, and test results and problems encountered are discussed. The reactor and safety rod drive operating experience is tabulated. Photos and schematic drawings are included. R.N.A.

N65-24958# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
POSTIRRADIATION EVALUATION OF ZIRCALOY PRESSURE TUBES FROM KER-1 AND KER-2
R. C. Aungst Mar. 1965 18 p refs
(Contract AT(45-1)-1830)
(BNWL-42) CFSTI: $1.00

Two Zircaloy-2 pressure tubes, fabricated by cold drawing to 30% reduction and tube reducing to 50% reduction, were subjected to postirradiation examination after exposure in a production reactor. Both tubes developed thin, tenacious, abrasion resistant, oxide films but no hydrogen increase resulted from the oxidation. The tube reduced material microstructure showed a marked agglomeration of second phase particles that became more severe as radiation dosage increased. No recrystallization or grain growth occurred in either tube. The high temperature ductility of the drawn tube was greater than the tube reduced material during irradiation. The drawn tube rupture strength and secondary creep rate were improved. Irradiation had no effect on crack propagation resistance for either tube. R.N.A.

N65-25157# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group
SUMMARIZED COMPATIBILITY REVIEW OF REACTOR MATERIALS FOR CO_2-COOLED GRAPHITE-MODERATED REACTORS
B. J. Seddon 1965 15 p Revision of TRG-267(W)
(TRG-842(R); TRG-267(W)) HMSO: 2s 6d

Information on the compatibility of a range of materials used in CO_2-cooled graphite-moderated reactors is presented in the form of tables based on compatibilities of materials with carbon dioxide, beryllium, Magnox, magnesium, uranium, and compatibilities of pairs of other relevant materials. Author

N65-25171# United Kingdom Atomic Energy Authority, Harwell (England). Safety Secretariat
A LIST OF MATERIALS WHICH MAY BE ACCEPTED FOR IRRADIATION IN BEPO BY THE SHIFT MANAGER, WITHOUT REFERENCE TO THE REACTOR MANAGER
J. K. Linacre Feb. 1965 31 p refs
(AERE-M-1535) HMSO: 4s 6d

Acceptance lists of materials and their irradiation conditions in a graphite moderated, natural uranium fueled, air-cooled reactor are presented. These lists refer to irradiations performed in belt stringers, control face rabbits, and vertical self-serve holes, and give the limits of the mass of material which may be accepted, the periods of irradiation considered, the quantity of material which may be accepted, the required container, and the reasons for the imposition of the various limits. Considered were inorganic chemicals, metals and alloys, gases, aqueous solutions, and miscellaneous materials, e.g., minerals. G.G.

N65-25173# United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering Div.
HEAT TRANSFER TO TWO-PHASE GAS–LIQUID SYSTEMS. PART 3: THE EFFECTS OF PROXIMITY OF OTHER HEATED SURFACES
J. G. Collier, P. M. C. Lacey, and D. J. Pulling Nov. 1964 32 p refs Revised
(AERE-R-3960)

Experiments were carried out in a test section which, in cross section, resembles part of a rod cluster-type fuel element for a boiling water reactor. Measurements were made of heat transfer coefficient, pressure drop, and burnout heat flux as a function of mass velocity, quality, rod spacing, and secondary heat flux on the surrounding elements. When burnout heat flux is plotted against exit quality, an apparent augmentation of the flux was noted for the condition where both surfaces of the duct were heated as compared to the value obtained with just the inner surface heated. Under certain conditions this increase may be explained by postulating a simple flow model incorporating current ideas on burnout, while for other conditions the picture is very confused. There does not appear to be any significant separate effect of secondary heating upon the heat transfer coefficient from the primary surface to the steam–water mixture or upon the pressure gradient. Author

N65-25179# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
THE MEASUREMENT OF THE THERMAL CONDUCTIVITY OF UO_2 UNDER IRRADIATION IN THE TEMPERATURE RANGE 150°–1600°C
D. J. Clough and J. B. Sayers Dec. 1964 76 p refs
(AERE-R-4690)

Two experiments to measure the thermal conductivity of polycrystalline sintered uranium dioxide continuously under irradiation by a radial heat flow method are described. The capsules were designed to give accurate control over a range of temperatures and to permit continuous measurement of the heat output from the specimen. Thermocouples were located both in the center line and circumferential positions in the fuel to eliminate corrections for the thermal resistance of the fuel

can interface. Annealing experiments showed that at intermediate dose levels a large fraction of the damage inserted at 180° and 320° C could be recovered by annealing at 450° and 750° C, respectively. As irradiation proceeded the fractional recovery that could be obtained decreased and above 10^{19} fission/cc little or no recovery was evident. Author

N65-25218# Atomics International, Canoga Park, Calif.
SNAP 10A FLIGHT SYSTEM PROTOTYPE (FSM-1) PERFORMANCE
L. L. Bixson, T. J. Boyle, J. H. Burgard, M. T. Marshall, H. Moore et al 15 May 1965 86 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10735) Available from AEC, Oak Ridge, Tenn.: $3.00

A summary and evaluation of the thermal tests performed on the SNAP 10A, FSM-1 thermoelectric power conversion system is presented. The unit was a developmental, nonnuclear, full-scale version of the nuclear-powered flight system. The overall results of the tests verified the validity of the flight system design. Reactor heat was developed by an electrical core heater. Liquid metal coolant pumped through the reactor core by a thermoelectrically driven, electromagnetic pump was maintained at an average temperature of over 920° F for more than 90 days. During this period a total of 831 kwh of energy was generated by the thermoelectric converter at an average power level of 400 watts. The test was performed in a vacuum environment to simulate the heat transfer characteristics encountered in space. Additional tests simulated conditions and the sequence of events from ground launch to nuclear startup in earth orbit. Author

N65-25289# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
YANKEE CORE EVALUATION PROGRAM Quarterly Progress Report, Period Ending 31 Mar. 1965
M. J. O'Boyle, comp. and ed. Apr. 1965 113 p refs
(Contract AT(30-1)-3017)
(WCAP-6075)

Continued research conducted under the Yankee Core Evaluation Program is reported. Included are data on efforts associated with the transportation, examination, and subsequent disposal of fuel assemblies; studies designed to evaluate chemical, metallurgical, engineering, and reactor physics data, as they relate to performance; and nuclear design methods. Major progress reported includes examinations of fuel assemblies and fuel rods of 14 core assemblies and one assembly cycled in Cores I and II; control rod examinations and performance evaluations; and an evaluation of the results from preliminary, two-dimensional X-Y depletion calculations performed for the axially averaged Yankee Core I. S.C.W.

N65-25297# Oak Ridge National Lab., Tenn.
MOLTEN-SALT REACTOR PROGRAM Semiannual Progress Report, Period Ending 28 Feb. 1965
R. B. Briggs Jun. 1965 187 p refs
(Contract W-7405-ENG-26)
(ORNL-3812) CFSTI: $5.00

Research on nuclear reactors that use mobile fuels (solutions of fissile and fertile materials in suitable carrier salts) is reported, with the major emphasis on developing a thermal breeder reactor. Components for fuel sampling, enriching and salt sampling systems, and water tank were completed. The freeze valves in the drain tank cell, coolant cell, and reactor cell were tested as part of the prenuclear operation of the reactor, and the freeze valves in the coolant system were revised to provide for an automatic drain on a power failure. Some gain in reactor breeding ratio was obtained by the use of unmoderated fuel salt blankets of thickness between 1.0 and 1.5 ft, but for fuel salt thicknesses greater than 1.5 ft the gain was very small. The stability of UF_3 as a solid in the presence of solid UF_4 and as a dissolved component of molten fluoride mixtures containing LiF and BeF_2 was studied through measurements of the equilibrium pressures of HF and H_2, thus equilibrium quotients were obtained and thermodynamic values were derived. An electrolytic hygrometer was tested for in-line monitoring of the removal of oxide from molten salt by treatment with hydrogen and hydrogen fluoride. The results indicated that HF should be removed completely from the gas that is bypassed to the analyzer. R.W.H.

N65-25309# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
FABRICATION OF SINTERED UO_2 PELLETS WITH CONTROLLED BORON CONTENT
E. Mizzan and R. Stack Feb. 1965 15 p refs
(AECL-2204) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

Sintered UO_2 pellets containing 40, 80, and 120 ppm boron were fabricated by sintering in argon at 1325° C followed by reduction in hydrogen at the same temperature and hydrogen cooling. Over 85% of the boron added was retained in the sintered pellets and the standard deviation of the boron content from pellet to pellet was ±0.6%. Author

N65-25332# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
IRRADIATION EFFECTS ON HIGH TEMPERATURE REACTOR STRUCTURAL METALS
T. T. Claudson and H. J. Pessl Feb. 1965 25 p refs
(Contract AT(45-1)-1830)
(BNWL-23)

The effects of radiation and high temperature environment on the mechanical properties of several nickel-base precipitation and solution hardenable alloys, and refractory metal alloys were investigated. The oxidation resistance of the nickel-base alloys was also evaluated. There was little effect on the mechanical properties of the nickel-base alloys irradiated at low temperature and tested at room temperature. However, high temperature irradiation and testing at 700° C caused a rapid deterioration of properties especially in the ductility of the material. Irradiation had a deteriorating effect on the ductility of refractory alloys tested at room temperature. Oxidation and corrosion data show an intergranular attack in nickel-base alloys with a large weight gain. Alloys with a small weight gain exhibited an oxide film that protected the alloy from rapid attack. Environmental pressure affects the corrosion and oxidation rates of the alloys. Refractory metal alloys experienced rapid corrosion even in 50° C water during irradiation. R.N.A.

N65-25333# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
FAST FLUX TEST FACILITY STUDIES Progress Report
E. R. Astley, ed. Apr. 1965 113 p ref
(Contract AT(45-1)-1830)
(BNWL-71) CFSTI: $4.00

Studies were based on (1) maximum use of components already proven in sodium-cooled reactor service, (2) maximum utilization of known sodium technology and (3) planned maximum possible utilization of existing sodium technology facilities and sites for required development. Additional conceptual

design data were obtained on tube-type reactor core, instrumentation system, type of building required and scope of Engineering Test Facility. Information was obtained on physics, materials selection, driver fuel development, sodium technology, analytical chemistry requirements, program management technology, and fast-flux irradiation testing needs for structural materials. The Fast Flux Test Facility concept will provide a versatile test facility for high energy neutron irradiation of fuels and structural materials for fast breeder reactors. The facility is centered about a fast test reactor equipped with a variety of instrumented open and closed loops and specimen irradiation stations for tests under conditions simulating actual core environments of fast breeder power reactors. The complex includes fuel and specimen handling and examination equipment and cells, a reactivity test facility, and a supporting engineering test facility. Author

N65-25334# Hanford Atomic Products Operation, Richland, Wash. Physics and Instruments Lab.
PHYSICS RESEARCH Quarterly Report, Oct.–Dec. 1964
F. G. Dawson, Jr., C. W. Lindenmeier, W. A. Reardon, P. L. Hofmann, H. L. Henry et al 15 Jan. 1965 88 p refs
(Contract AT(45-1)-1350)
(HW-84608) CFSTI: $3.00

Research studies in theoretical reactor physics, engineering physics, experimental reactor physics, and critical mass physics are described. Investigations included a study of three aqueous homogeneous plutonium nitrate critical spheres; an analysis of a materials testing reactor burnup cycle using low exposure plutonium core; results of critical experiments on fuel rods in the plutonium recycle critical facility; the migration area and moderator reactivity coefficients measured during experimental boiling water reactor critical experiments; critical experiments with PuO_2–polystyrene compacts; and subcritical measurements for nuclear safety guidance. R.N.A.

N65-25370# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
NONDESTRUCTIVE TEST OF CARBON BEDS FOR REACTOR CONTAINMENT APPLICATIONS Progress Report, Apr.–Jun. 1964
David R. Muhlbaier Nov. 1964 12 p refs
(Contract AT(07-2)-1)
(DP-920) CFSTI: $1.00

A standardized nondestructive and more generally applicable test for installed carbon beds that are used in reactor containment facilities is being developed by the Savannah River Laboratory. Continuing tests show that the permissible ranges of air velocity and H_2O content of the carbon are increased significantly by substituting "F-11" or "F-114B2" for "F-12"—a more volatile "Freon" that was used in an earlier testing method. Author

N65-25409*# Oak Ridge National Lab., Tenn.
SNAP-8 CORROSION PROGRAM Quarterly Progress Report, Period Ending 28 Feb. 1965
H. W. Savage, E. L. Compere, R. E. Mac Pherson, W. R. Huntley, and A. Taboada Jun. 1965 44 p refs
(NASA Order C-220-A; Contract W-7405-ENG-26)
(NASA-CR-63196; ORNL-3823) CFSTI: HC $2.00/MF $0.50

Hydrogen solubilities in NaK-78 were determined for a temperature range of 572° to 1300° F as a function of hydrogen pressure from a few millimeters to 1 atm, and Sievert's law was found to hold for this system. Evidence of solid hydride precipitation was observed below 752° F. For estimated hydrogen pressures in the SNAP-8 primary coolant, these data indicate a hydrogen concentration in the NaK of 1 ppm and precipitations of solid hydrides at about 300° F. Also, the ratio of permeability of deuterium and hydrogen through type 316 stainless steel was found to be 0.68 at 1100° F and 0.74 at 1300° F. Further, studies of the phase equilibria of the Na–K–Li–H system at 1100° F indicate that in all cases the addition of lithium greatly lowers the partial pressure of the hydrogen at equivalent hydrogen concentrations. This is apparently due to the hydrogen combining with the alkali metals in proportion to their concentration and affinity for hydrogen. The limited solubility of lithium hydride results in precipitation, which inhibits the pressure changes until available lithium is exhausted. E.E.B.

N65-25449# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
SPENT NUCLEAR FUEL AS A SOURCE OF GAMMA RADIATION
W. M. Campbell and R. C. Hawkings Feb. 1965 19 p refs Presented at Am. Nucl. Soc.–Can. Nucl. Assoc. Meeting, 12 Feb. 1965
(AECL-2210) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

Gamma-emitting fission products which might be used in radiation processes will be available either as spent fuel elements or as concentrated mixed fission products, probably in the form of glass. The glass could have up to 10 times the radiation intensity of the spent fuel, but this is still much lower than that of Co^{60} normally used for industrial purposes. Various factors associated with the use of this power reactor by-product are discussed, and it is concluded that low radiation intensity is the main disadvantage. The real potential, however, can be evaluated only by a more detailed assessment of particular processes using fission product sources. Author

N65-25478# United Kingdom Atomic Energy Authority, Risley (England).
THE REACTION OF PLUTONIUM DIOXIDE WITH THE OXIDES OF SEVERAL ELEMENTS FORMED DURING NUCLEAR FISSION
C. Keller 1965 17 p refs Transl. into ENGLISH from Z. Metallk. (Stuttgart), v. 55, no. 8, 1964 p 466–472
(TRG-448(D)) HMSO: 2s 6d

Several oxide phases and binary oxides of plutonium, with plutonium valencies from three to six, are obtained by solid state reactions of Pu_2O_3 or PuO_2 with oxides of several elements. From the reaction conditions it can be concluded that compounds of this kind are formed at high burnup in oxide nuclear fuels containing plutonium. The properties and stability of these compounds are discussed. Author

N65-25479# United Kingdom Atomic Energy Authority, Risley (England).
THE PHYSICAL PROPERTIES OF PLUTONIUM-BEARING OXIDES. PART I: THERMAL CONDUCTIVITY
R. J. Warmer 1965 20 p refs
(TRG-586(D), Pt. 1)

This report reviews the theories of thermal conductivity as they apply to plutonium oxide and plutonium dioxide–uranium dioxide with reference to their use as fast reactor fuels. Methods for determining the thermal conductivity are suggested. Author

N65-25480# United Kingdom Atomic Energy Authority, Risley (England).
THE PHYSICAL PROPERTIES OF PLUTONIUM-BEARING OXIDES. PART 2: REVIEW OF DATA OTHER THAN THERMAL CONDUCTIVITY
R. J. Warmer 1965 28 p refs
(TRG-586(D), Pt. 2)

This report reviews the relative importance of the physical properties, other than thermal conductivity, of plutonium dioxide and plutonium dioxide–uranium dioxide from the standpoint of a fast reactor fuel. Methods for determining these properties are reviewed and compared with those for UO_2. Author

N65-25483# United Kingdom Atomic Energy Authority, Risley (England).
POISSON'S RATIO OF REACTOR GRAPHITE AND THE EFFECT OF IRRADIATION
J. E. Brocklehurst and J. T. Lynam 1965 14 p refs
(TRG-901(C))

Measurements of Poisson's ratio on small graphite samples are described, and an increase in the Poisson ratio of P.G.A. graphite under fast-neutron irradiation at 150°C is reported. The results are discussed in terms of current ideas on graphite deformation and irradiation damage, and are relevant to calculations of self-stressing in graphite blocks. Author

N65-25485# United Kingdom Atomic Energy Authority, Risley (England).
THE EFFECTS OF ANNEALING ON THE DIMENSIONAL AND THERMAL EXPANSION CHANGES INDUCED IN PYROLYTIC GRAPHITE BY IRRADIATION AT 170°C
B. T. Kelly, W. H. Martin, A. M. Price and K. Smith 1965 10 p refs
(TRG-909(C))

The large changes in dimensions and principal thermal expansion coefficients of pyrolytic graphite induced by fast-neutron irradiation at 170°C are shown to be annealed out completely at a temperature of 2200°C, in agreement with electron microscope studies. The effect of annealing on the thermal expansion coefficients is shown to correlate with changes in the c-axis lattice parameter. The effect of annealing on the dimensional changes is discussed in terms of models of irradiation damage in graphite. Author

N65-25486# United Kingdom Atomic Energy Authority, Risley (England).
ARGOSY RESULTS FOR THE LONG-TERM IRRADIATION CHANGES IN THE CALDER HALL REACTOR
C. F. Griggs and R. Richmond 1965 12 p refs
(TRG-917(W)) HMSO: 1s 9d

The measured values of the heavy isotope contents of irradiated Calder fuel elements are compared with ARGOSY calculated values. Agreement is satisfactory within experimental errors which are of the order of 1% to 1 1/2%. Since most of the neutron captures in ^{238}U occur below the resonance energy region, it is not possible to use this comparison to check the validity of the factor 0.9 applied to the resonance integral of the program ARGOSY 2A and later versions. Author

N65-25487# United Kingdom Atomic Energy Authority, Risley (England).
STUDIES OF RANDOM FLUCTUATIONS OF D. F. R. POWER
D. C. Menzies and A. M. Backhouse 1965 21 p refs
(TRG-921(D)) HMSO: 3s

Recordings of fluctuations in the reactor flux were analyzed, and the autocorrelation function of the flux signals measured. Two features appear in all correlation functions: (1) a damped oscillation with a frequency proportional to coolant flow-rate, and a damping time-constant, identified with the fuel time-constant, of about 0.4 sec; and (2) a long exponential decay with an apparent time-constant of about 50 sec and an amplitude which has remained constant, within expected statistical variations, over the whole period covering all measurements. Author

N65-25489# United Kingdom Atomic Energy Authority, Risley (England).
RATIO OF FAST- TO THERMAL-NEUTRON FLUX IN HOLLOW 150 g FUEL ELEMENT FACILITIES IN DIDO AND PLUTO
W. H. Martin and D. M. Clare 1965 7 p refs
(TRG-957(C)) HMSO: 1s 6d

The variation of the ratio of fast- to thermal-neutron flux in a hollow 150 g fuel element in DIDO or PLUTO, with mean weight of ^{235}U in the element during the irradiation, obtained by direct measurement of fast- and thermal-neutron doses, is significantly less than previously indicated by measurements made at low reactor power. Therefore, fast-neutron doses obtained by measuring thermal-neutron dose and using the low-power relationship are lower than directly measured fast-neutron doses by up to 20% at 30% mean fission burnup of ^{235}U. Author

N65-25490# Atomic Energy Establishment, Winfrith (England). Technical Assessments and Services Div.
ENOCH: A ONE-DIMENSIONAL SPACE DEPENDENT BURN-UP PROGRAMME
M. C. Wilkinson 1965 35 p refs
(AEEW-M-448) HMSO: 4s 6d

The ENOCH code is designed for radial burnup studies in cylindrical reactors. It uses a four-group model of the neutron physics and a library of point burnup data computed with METHUSELAH or some similar code. Provision is made for representing charge, discharge, or shuffling of the annular zones according to preset fuel management scheme. Author

N65-25491# Atomic Energy Establishment, Winfrith (England). Reactor Development Div.
THE PREDICTION OF BURNOUT IN NON-UNIFORMLY HEATED ROD CLUSTERS FROM BURNOUT DATA FOR UNIFORMLY HEATED ROUND TUBES
P. G. Barnett Nov. 1964 68 p refs
(AEEW-R-362) HMSO: 9s

The practice of using burnout data for uniformly heated round tubes to predict burnout in nonuniformly heated reactor channels having complex cross sections is examined. At least two hypotheses are involved: (1) a relationship exists between uniform and nonuniform heat flux distributions, and (2) a relationship exists between simple and complex channel cross sections. Use of two such hypotheses each accurate to ±15% and a correlation of uniformly heated round tube data having an rms error of 5%, could yield errors of ±40% in any predicted value; this figure of ±40% is regarded as a relistic upper limit for design purposes. It is shown that no method can exist for relating different channel cross sections to within ±15% and existing methods for relating different heat flux distributions incur some errors exceeding 20%. Furthermore, any suggested method for relating different heat flux distributions can be adequately checked only when a sufficiently large number of results are available and then the preferable alternative of

correlating the data is possible. It is concluded that no reliable method can exist for predicting burnout in rod bundles from uniformly heated round tube data with sufficient accuracy for design purposes. Author

N65-25492# Atomic Energy Establishment, Winfrith (England). General Reactor Physics Div.
EFFECTIVE CADMIUM CUT-OFF ENERGIES IN CYLINDRICAL GEOMETRY FOR FISSILE AND 1/v DETECTORS
E. J. Maunders Dec. 1964 24 p refs
(AEEW-R-403)

The importance of geometry in detector-filter arrangements used for integral neutron spectrum measurements is discussed, and cadmium transmission functions are presented for a number of detectors ranging from cylinders of 0.040 in. o.d. to slabs of finite thickness and infinite extent, with close fitting filters of thickness 0.030, 0.040, and 0.050 inches. The transmission function as defined is dependent on the physical size of the detector, and the importance of this consideration is also demonstrated. In addition, the transmission functions were used to determine the effective cadmium cutoff energies for Pu^{239}, U^{235}, U^{233}, and 1/v detectors. Author

N65-25495# United Kingdom Atomic Energy Authority, Harwell (England). Engineering Div.
THERMAL TESTS ON AN INSULATED, LARGE SOURCE, COBALT 60 CONTAINER, DESIGN NO. 0063
F. E. Dixon, A. H. Partridge, and A. J. Brook Apr. 1965 31 p, refs
(AERE-M-1511) HMSO: 4s 6d

Tests were made to determine temperature rise in the ventilated insulating shield of a container carrying 105 000 curies of Cobalt 60, and to measure the effect of blocking ventilation holes as might occur in an accident. It is shown that the ventilated and unventilated thermal shields do not cause overheating of the container. Author

N65-25496# United Kingdom Atomic Energy Authority, Harwell (England). Engineering Div.
A STANDARD SERIES OF PACKAGINGS FOR LOADS UP TO 20 000 CURIES OF COBALT 60 OR EQUIVALENT
F. E. Dixon Apr. 1965 12 p refs
(AERE-M-1512) HMSO: 1s 9d

This paper discusses a comprehensive range built up largely from an existing standard range, but with the addition of features necessary to comply with the regulations, together with an extension of the range to carry up to 20 000 curies of Cobalt 60 or equivalent. This gives a comprehensive range of shielding thicknesses, all of which can be type B approved and some of which are used also as type A packaging. The series caters for a large proportion of the isotope traffic. Author

N65-25497# United Kindgom Atomic Energy Authority, Harwell (England). Safety Secretariat
PROCEDURE FOR INTENDING USERS OF THE HARWELL REACTORS
A. E. Truswell Dec. 1964 26 p
(AERE-M-1518) HMSO: 3s 6d

This document describes the procedure for examining safety aspects of all experimental irradiations in reactors. Before any experiments are carried out the experimentalist, or the user, must satisfy the reactor manager that the experiment will not endanger the reactor or personnel. This procedure is not required for irradiation of small amounts of material requiring only the use of existing standard irradiation equipment. Author

N65-25498# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
RADIATION INDUCED CREEP IN GRAPHITE
A. J. Perks and J. H. W. Simmons Aug. 1963 23 p refs
(AERE-R-4372)

Experiments on radiation induced creep in graphite carried out in a high flux reactor are described. Samples of graphite were loaded under tension at about 500 psi and their subsequent changes in length compared with those of similar samples irradiated with no stress and those of samples held in the same stress and at the same temperature out of pile. Results indicate the existence of a radiation induced creep strain. Experiments were also carried out on the effect of annealing both with and without stress on the lengths of samples which (1) had received no previous treatment, (2) had been irradiated with no stress, and (3) had been irradiated under stress. Alternative explanations of radiation creep are discussed. It is suggested that radiation creep plays a part in the dimensional changes of graphite irradiated without an external load. Author

N65-25499# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
THE EFFECT OF IRRADIATION ON THE MICROSTRUCTURE OF HOT PRESSED BeO
H. J. Woolaston and R. S. Wilks Aug. 1963 15 p refs
(AERE-R-4404)

Milford Haven hot pressed BeO has been irradiated in DIDO at 150° C to doses in the range 2.4×10^{19} to 1.7×10^{20} nvt $\geq$ 1 MeV. It was examined, before and after irradiation, by optical microscopy and replica electron microscopy. Before and after irradiation, negative crystal pores and small pores (0.02μ to 0.1μ diameter) are present. There is no evidence of the formation of helium bubbles even after annealing at temperatures up to 1500° C. A little cracking was seen by optical microscopy in large, but not in small, grain size BeO before irradiation. After irradiation more cracking was visible, and increased with the dose received by the specimen. The effect on the cracking of annealing at temperatures up to 1500° C was studied. The results are in general accord with theoretical expectations. Author

N65-25506# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
CALORIMETRIC DOSIMETRY FOR REACTOR IRRADIATION EXPERIMENTS. PART 3: THE MEASUREMENT OF ENERGY ABSORBED IN HYDROCARBONS IN BEPO
J. K. Linacre, C. R. V. Reed, N. K. Taylor, and R. B. Thomas Feb. 1965 56 p refs
(AERE-R-4807)

A calorimetric measurement of the dose rate in the hydrocarbon anthracene ($C_{14}H_{10}$) is described. A calorimeter with an anthracene sample contained in a thin steel vessel is operated with a second instrument measuring the dose rate in an identical empty vessel, and the dose rate in anthracene determined by difference. The instruments have operated in BEPO for over a year. The corrections to the dose rate measured to determine the ideal dose rate from reactor radiation are discussed. The anthracene and blank calorimeter were operated with a graphite calorimeter and the data analyzed to find the dose rates from gamma radiation and fast neutron radiation separately. For graphite in BEPO, the fraction of the total dose rate arising from fast neutron scattering is found to be 0.44, which is in reasonable agreement with calculations. Dose rates in other materials used in radiation chemistry experiments are calculated. Author

N65-25520# Atomics International, Canoga Park, Calif.
AEC UNCLASSIFIED PROGRAMS Quarterly Technical Progress Report, Jan.–Mar. 1965
15 Apr. 1965 276 p
(Contract AT(11-1)-GEN-8)
(NAA-SR-11200) CFSTI: $6.00

Research was conducted and reports were published on *Sodium Reactor Experiment*—SRE power expansion program; *Large Sodium–Graphite Reactors*—technical information on which to base the construction of a large SGR; *Fast Reactor Development*—development and evaluation of a reference coupled, fast reactor concept; *Sodium–Cooled Reactors Component Development*—development and testing of reliable and economic heat-transfer components; *Piqua Nuclear Power Facility Development*—design of PNPF core II and development of its fuels; *Fuel Surveillance*—performance evaluation of various fuels; and *Advances Development*—multicycle processing, and other studies. G.G.

N65-25544# California Univ., Livermore. Lawrence Radiation Lab.
STABILITY OF CRACKED TUBES AT ELEVATED TEMPERATURE AND HIGH FLOW RATE
E. Robinson and W. Wells 10 Apr. 1965 16 p
(Contract W-7405-ENG-48)
(UCRL-7369 Suppl. I)

Stability test results are presented for cracked ceramic hexagonal fuel element tubes at elevated temperatures and high flow rate. Results indicate that a large amount of cracking may exist in a matrix of hexagonal tubes without fragmentation or collapse. Severely precracked tubes withstood radial temperature gradients of at least 100° F, flow rates of 0.1 lb/sec per tube, and with no effect on the integrity of the flow passages. The tubes also survived a shakedown test. R.N.A.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N65-24396# Massachusetts Inst. of Tech., Cambridge. Cryogenic Engineering Lab.
THE PRODUCTION OF INTENSE MAGNETIC FIELDS BY MEANS OF LIQUID NITROGEN COOLED COPPER COILS Final Report
D. W. Almgren and R. D. Cummings Feb. 1965 82 p refs
(Contract AF 19(604)-7460)
(AFCRL-65-1; AD-613967)

The problem of production of intense, continuous magnetic fields using low-temperature coils was studied. Using a standardized 5-in.-o.d. 2 1/2-in.-wide solenoid configuration, a variety of coolant passage geometries and coil manufacturing techniques for producing coolant passages were tested. The solenoids are evaluated on the basis of cooling ability (power dissipated for a maximum flux density) and ease of manufacture. With liquid nitrogen being supplied at a rate of approximately 50 GPM, a maximum flux density of 77 kG was measured in a 5 in. air bore while dissipating 86 kW of power. Author

N65-24404# Technical Research Group, Inc., Melville, N. Y.
PERTURBED FABRY–PEROT RESONATORS Scientific Report No. 2
Stephen R. Barone Bedford, Mass., AFCRL, Jan. 1965 35 p refs
(Contract AF 19(604)-8817)
(TRG-160-SR-2; AFCRL-65-173; AD-613684)

A theory of discrete resonances of a Fabry–Perot interferometer is generalized to include configurations departing from ideal geometry. It centers on an asymptotically valid differential equation plus impedance boundary conditions for transverse resonance behavior. For strip mirrors the complex resonant frequencies are evaluated to second order as functionals of the mirror shapes, and the result is applied to slightly curved and tilted mirrors. For curved mirrors the theory appears valid for moderately large Fresnel number and for Fresnel numbers of the order of unity. Exact solution of the transverse resonance equation for tilted mirrors is also presented, and for moderately large angles of tilt interpreted in terms of two overlapping sets of fringes modified by progressive phase and amplitude factors. Corresponding solution for complex resonant frequencies requires study of an algebraic transverse resonance equation. Extension of this theory to circular mirrors is indicated, and the first order result for the complex resonant frequencies is presented. This is used to derive explicit expressions for the frequency shifts and modal lifetimes in the case of slight parabolic mirror curvature. Author

N65-24410# Naval Ordnance Lab., White Oak, Md. Mathematics Dept.
PROGRAM FOR THE STABILITY ANALYSIS OF A TOWED BODY
Elias V. Schuman 27 Oct. 1964 24 p refs
(M-55; NOLTR-64-139; AD-614102)

Two computer programs are discussed which analyze the stability of a body towed in air. A detailed description of input and output is included. Author

N65-24420# Pennsylvania Univ., Philadelphia. Lab. for Research on the Structure of Matter
LABORATORY FOR RESEARCH ON THE STRUCTURE OF MATTER Annual Report, 1 Jul. 1963–30 Jun. 1964
John N. Hobstetter [1965] 173 p refs
(Contract ARPA SD-69)
(AR-4)

Research project reports, abstracts, publications, and other information originating from this laboratory in the fields of analytical chemistry, cryogenics, electrical microscopy, high magnetic field, magnetic resonance, materials processing, metallography, microwave spectroscopy, spectroscopy, and X-ray diffraction are presented. R.C.S.

N65-24446# France Office National d' Etude et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
THEORETICAL STUDY OF THE PROPAGATION OF SOUND. APPLICATIONS TO THE ANTICIPATION OF EXPLOSIVE NOISE CAUSED BY SUPERSONIC FLIGHT [ETUDE THEORIQUE DE LA PROPAGATION DU SON. APPLICATIONS A LA PREVISION DU BRUIT BALISTIQUE PROVQQUE PAR LE VOL SUPERSONIQUE]
Jean-Pierre Guiraud Feb. 1964 348 p refs In FRENCH
(TP-104(1964))

Running notes from a lecture course on the propagation of sound are presented. Discussions include acoustic equations, first solutions of the wave equations, fundamental solutions and

the Cauchy problem, and applications to acoustic field gradients in flight. Oscillation generalities discussed include establishment of an oscillatory regime. Green formulations, some results, conditions, and potentials, and the existence and uniqueness of the problem. Some problems of diffraction are resolved, and acoustic geometrics are considered and applied to a vehicle in supersonic flight. M.P.G.

N65-24459# Purdue Univ., Lafayette, Ind. School of Aeronautics, Astronautics, and Engineering Sciences
THERMODYNAMIC RESTRICTIONS ON SECOND ORDER FINITE VISCOELASTICITY
George Lianis Mar. 1965 17 p refs
(Grant NSF GP-2677)
(A&ES-65-4)

The thermodynamic theory of simple materials with fading memory is applied on the second-order terms of the constitutive equation for the stress tensor. It is found that such terms derived from a mechanical theory are restricted by thermodynamics to obey certain symmetry relations. The results are applied to isotropic viscoelastic materials and to simple fluids. Author

N65-24559*# National Aeronautics and Space Administration, Washington, D. C.
MOTION OF A PENDULUM WITH STRONG DAMPING ON A VIBRATING BASE [O DVIZHENII MAYATNIKA S SIL'NYM DEMPFIROVANIYEM NA VIBRIRUYUSHCHEM OSNOVANII]
D. M. Klimov May 1965 6 p ref Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 4, 1964 p 142–143
(NASA-TT-F-363) CFSTI: HC $1.00/MF $0.50

The motion of a pendulum with its axis oriented vertically is investigated. It is shown that vibration of the base gives rise to a slow unidirectional rotation on the part of the pendulum. The mean angular velocity of this rotation is calculated. Author

N65-24597# AVCO-Everett Research Lab., Everett, Mass.
WIDE ANGLE LENSES WITH ASPHERIC CORRECTING SURFACES
Robert T. Jones May 1965 19 p refs *Its* Res. Rept. 215
(Contract AF 04(694)-623)
(BSD-TR-65-242; AD-462317)

Refracting elements having aspheric correcting surfaces near the center of curvature are analyzed. As in the case of the Schmidt reflector, such systems can have a wide aperture and a wide field of view, and in addition are free from obstructing surfaces. Being uncorrected for dispersion however, the refracting systems are restricted to nearly monochromatic radiation. Typical forms of the correcting surfaces were determined, both by third-order theory and by numerical integration of exact equations. Author

N65-24615# Society of Automotive Engineers, Inc., New York.
RECOMMENDED MATERIALS AND PRACTICES FOR USE WITH CRYOGENIC PROPELLANTS
Alan F. Schmidt, comp. 10 Jan. 1965 29 p refs
(AIR-839) Available from NBS, Boulder, Colo.: $2.00

A report designed to provide a basis for a summary evaluation of selected cryogenic propellants is presented. Included are general data on recommended materials and practices for use with cryogenic propellants, and specific data as related to liquid oxygen and hydrogen. Also included are a comprehensive annotated bibliography, and a tabular summary of the physical properties of each propellant. Health, fire, and explosion hazards; safety measures; and transfer and storage techniques are considered. S.C.W.

N65-24692# Joint Publications Research Service, Washington, D. C.
MEASUREMENTS OF ELEMENTS OF THE GRAVITATIONAL FIELD WHILE IN MOTION
K. Ye. Veselov 31 May 1965 12 p Transl. into ENGLISH from Priklad. Geofiz. (Moscow), no. 40, 1964 p 120–126
(JPRS-30334; TT-65-31117) CFSTI: $1.00

Discussed is the development of equipment to measure the parameters of a gravitational field from an aircraft through differentiation between the gravity acceleration and the motion acceleration. It was concluded that this equipment should contain: (1) precise horizon stabilization and metering devices for the motion trajectory elements to measure the gravity force; (2) a null-balance measurement method and an accurate horizon stabilization system to measure the first derivation of the gravity force along the sensitivity axis; and (3) a null-balance method of measurement to obtain the second derivation of the gravity force along the sensitivity axis. G.G.

N65-24773*# Columbia Univ., New York.
ABSORPTION OF SOUND IN AIR BELOW 1000 CPS
Cyril M. Harris and W. Tempest Washington, NASA, Jun. 1965 65 p refs
(Contract NAS8-11002)
(NASA-CR-237) CFSTI: HC $3.00/MF $0.75

The purpose was to extend to lower frequencies the present range of reliable air absorption data. The report presents such information in the frequency range from about 125 to 1000 cps at 20°, 0°, and −40° C. Data described can be applied to studies of acoustic propagation in the atmosphere in addition to establishing a theoretical model of sound absorption in air. In this connection measurements were made of the absorption in mixtures of oxygen and water vapor and in mixtures of oxygen and deuterium oxide. Author

N65-24790# Liège Univ. (Belgium).
DETERMINATION OF INFERIOR AND SUPERIOR TERMINALS IN INFLUENCIAL COEFFICIENTS IN A HYPERSTATIC TRUSSED STRUCTURE [DETERMINATION DE BORNES SUPERIEURES ET INFERIEURES AUX COEFFICIENTS D'INFLUENCE DANS UNE STRUCTURE HYPERSTATIQUE EN TREILLIS]
Alfred Genot Repr. from Rev. Universelle Mines (Liège), ser. 9, vol. 17, no. 5, May 1961 p 1–12 refs In FRENCH

In hyperstatic trussed structures, exact determination of the direct and reciprocal influence coefficients of displacement of any type of node involves a series of laborious calculations. Introduction of hypotheses concerning the elasticity of the system permits rapid calculation of approximate values for these coefficients. It is shown that for a structure with fixed support, and in which the material obeys Hooke's law, it is possible to calculate upper and lower bounds on both coefficients. These calculations are illustrated in an example. Transl. by J.M.D.

N65-24880 Joint Publications Research Service, Washington, D. C.
PROGRESS IN SUPERSONICS

Ch'ung-fu Ying *In its* Transl. on Communist China's Sci. and Technol., No. 181 25 May 1965 p 1–7 Transl. into ENGLISH from K'o-hsueh Ta-chung (China), no. 3, Mar. 1965 p 3–5 (See N65-24879 14-34) CFSTI: $3.00

Numerous applications of supersonics are described. Exploitations of the phenomena of high-frequency sound waves can be categorized under the headings of detection, control, processing, and cleaning. Inaudible sound was first studied in the guidance mechanism of the bat. The first application was during World War I, when a submarine detector was devised which was based on a quartz crystal unit that functioned as a supersonic wave generator. Other specific applications discussed include devices for locating schools of fish, emulsifying incompatible liquids, drilling in glass, cutting germanium and silicon for semiconductor materials, making medical diagnoses, measuring thickness of solids, amplifying sound, and for washing various objects. J.M.D.

N65-24881 Joint Publications Research Service, Washington, D.C.

THE WHISTLE THAT PRODUCES SUPERSONIC WAVES

Kuo-pao Shis and Chih-chiang Wu *In its* Transl. on Communist China's Sci. and Technol., No. 181 25 May 1965 p 8–12 Transl. into ENGLISH from K'o-hsueh Ta-chung (China), no. 3, Mar. 1965 p 10–11 (See N65-24879 14-34) CFSTI: $3.00

A supersonic whistle used in emulsifying liquids and grinding powders is described. The whistle is a gas-powered supersonic wave generator, which consists of a narrow crack orifice through which liquid is sprayed onto a vibrating rectangular metal reed. Two types of reed supersonic whistles, the 4-fulcrum and cantilever models, are discussed. Experiments in mixing petroleum, castor oil, paraffin, and turpentine in water resulted in highly stable emulsions. These devices are used in homogenizing lactalbumin in milk and oil based insecticides in water. Reed whistles are used in reducing dye particles to fine powder and in preparation of starch for textile weaving. They have also been used in manufacture of drugs, food, and fuels. The mechanism behind the grinding and emulsifying ability of the reed supersonic whistle is poorly understood at present, but it is conjectured that such machines will eventually replace mechanical grinding and stirring devices. J.M.D.

N65-24963 Ohio State Univ., Columbus. Engineering Experiment Station

NONLINEAR OPTICAL PHENOMENA

Paul N. Butcher [1964] 142 p refs *Its* Bull. No. 200 Available from Ohio State Univ.: $3.50

The development of q-switched lasers led to a variety of nonlinear optical phenomena of small dimensions in samples of suitable materials. This theoretical analysis shows how the various nonlinear optical effects arise from the nonlinear constitutive relation between the optical electric field and the polarization which it sets up in a medium. The solution of Maxwell's equations when the nonlinear terms in the polarization are taken into account is considered. This leads to a more detailed treatment of the phenomena of optical rectification, second harmonic generation, the Pockles effect, parametric amplification, third harmonic generation, the Kerr effect, two-photo absorption, and the stimulated Raman effect. G.G.

N65-24977*# IIT Research Inst., Chicago, Ill. Technology Center

INVESTIGATION OF LIGHT SCATTERING IN HIGHLY REFLECTING PIGMENTED COATINGS Quarterly Report, 1 Feb.–1 May 1965

G. A. Zerlaut, S. Katz, B. H. Kaye, and V. Raziunas 13 May 1965 39 p refs
(Contract NASr-65(07))
(NASA-CR-63118; IITRI-C6018-14)

The work discussed represents continuing theoretical efforts to elucidate the mechanism of multiple scattering in concentrated pigmented films, and continued experimental studies of the optical properties of carefully prepared arrays of silver halide particles. The theoretical work involves both the adaptation of classical light-scattering theory and the generation of random-walk concepts to explain the multiple interaction problem. The reflectance measurements of simulated bimodal coatings indicate that the backscatter intensities due to each particle size are additive and that particles in thin films tend to act as independent scatterers. The spectral backscatter coefficients for these bimodal suspensions are also presented. Values of backscatter intensity obtained from the reflectance measurements of the mixtures were consistently less than those predicted from measurements of monodisperse films. Author

N65-24999*# National Bureau of Standards, Boulder, Colo. Cryogenics Div.

A BIBLIOGRAPHY OF EXPERIMENTAL SATURATION PROPERTIES OF THE CRYOGENIC FLUIDS

N. A. Olien and L. A. Hall 9 Apr. 1965 121 p refs
(NASA Order R-45)
(NASA-CR-62880; NBS-TN-309) GPO: $0.60; CFSTI: MF $1.00

N65-25127 Lockheed Missiles and Space Co., Palo Alto, Calif. Electronic Sciences Lab.

ATOMIC PHYSICS: RAMSAUER SCATTERING

D. E. Golden, H. W. Bandel, and H. Nakano *In its* Progr. Rept. Jan.–Mar. 1965 [1965] 10 p refs (See N65-25125 14-34)

Electron atom scattering cross sections of the constituents of the atmosphere down to very low values of electron energy using electron beams of very sharply defined energy were investigated. The technical approach was to use magnetic momentum selection so as to obtain a beam of electrons with a sharply defined energy. The electrons are then allowed to interact with the gas and the unscattered beam is collected. A study of the beam attenuation as a function of gas pressure yields the total cross section directly. The apparatus used to measure the total electron atom scattering cross sections is shown. The absolute total electron-helium atom cross section from 0.300 to 28.0 eV was measured with an estimated probable error of 3%. The values for electron energies less than 4 eV are given. Also, the absolute total electron-argon atom cross sections as a function of electron energy were measured from 0.10 to 21 eV. The results were in agreement with previous values to within 20%. The Ramsauer minimum was found at 0.25 eV which is in disagreement with other measurements. E.E.B.

N65-25136 Lockheed Missiles and Space Co., Palo Alto, Calif. Electronic Sciences Lab.

THEORETICAL INVESTIGATION OF FORCES BETWEEN DIPOLE ARRAYS

N. Kusnezov *In its* Progr. Rept., Jan.–Mar. 1965 [1965] 17 p (See N65-25125 14-34)

A theoretical investigation of the previously obtained experimental results is reported. The theoretical analysis consists of the formulation of general expressions for forces acting on dipole arrays; the calculation of forces between two dipole planes; and a consideration of the forces associated with systems of dipole planes. E.E.B.

N65-25137 Lockheed Missiles and Space Co., Palo Alto, Calif. Electronic Sciences Lab.
EXPERIMENTAL INVESTIGATION OF FORCES IN MAGNETIC DIPOLE ARRAYS
S. R. Hawkins and J. H. Harshman *In its* Progr. Rept., Jan.–Mar. 1965 [1965] 7 p ref (See N65-25125 14-34)

Tests were performed to determine experimentally whether the force area between parallel sheets of magnetic dipoles is a function of the area of the sheets. The sheets were made from 10 mil thick Mylar which was perforated in a square array with 20-mil diameter holes with 40 mils between centers. The holes were filled with barium ferrite powder mixed with a binder. The density of the composite after room temperature curing was about 90% of that of the ferrite. The sheets were magnetized with a 14 in. electromagnet using a field in excess of 5 kG. Force vs. separation measurements for pairs of magnetized sheets of various areas are shown. Also, force/unit area vs. separation for the same test samples are given. It was observed that force/unit area decreases with area. Further, tests were made to determine if a square array or a triangular (hexagonal) array of magnetic dipoles produces a larger force. It was found within experimental limits that the square produces the larger force. Further, a test was performed to determine the force-separation relationship between a single sheet and a double sheet of dipoles. It was found that the forces in a multisheet array are simply additive. E.E.B.

N65-25142 Lockheed Missiles and Space Co., Palo Alto, Calif. Electronic Sciences Lab.
LIGHT DIFFRACTION BY ULTRASONIC WAVES
H. V. Hance and J. K. Parks *In its* Progr. Rept., Jan.–Mar. 1965 [1965] 7 p refs (See N65-25125 14-34)

An experimental investigation was made to determine the following: (1) that an ultrasonic beam can cause substantially complete transfer of power from an incident laser beam into one diffraction order; (2) that modulation bandwidth is inversely proportional to the transit time of the ultrasonic wave across the light beam and inversely proportional to the light beam diameter; (3) that an ultimate limit on modulation bandwith is reached at about 1/8 of the ultrasonic carrier frequency. The variation of light beam intensity in the diffracted (1st order) and undiffracted (0 order) beams emerging from the ultrasonic cell is shown. At a value of 3.2 for the parameter proportional to ultrasonic amplitude, the transfer of power to the diffracted beam is nearly complete. Also, it was shown that the bandwidth limitation in each case was correlated with the theoretical limit set by the diameter of the light beam at its focal point. The ultimate limit set by ultrasonic carrier frequency was closely approached when the carrier frequency used was 35 Mc, but when it was 87.5 Mc bandwidth limiting in the modulator-driver prevented the theoretical limit from being reached. E.E.B.

N65-25196# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Environmental Science Directorate
THE INVERSE PROBLEM IN ELECTROMAGNETIC SCATTERING FROM CYLINDERS. I: A UNIQUENESS THEOREM
Ramon Mireles Apr. 1965 38 p refs
(ERDA-280; AD-462054)

The relative intensity functions for cylindrical scattering are known functions of the scattering angle, the size ratio, and the complex index of refraction for the cylinder. These functions are examined to show that distinct combinations of size ratio and complex index of refraction invariably lead to relative intensity scattering functions which must disagree on some open subinterval of the domain $[0,\pi]$ of the scattering angle. A general theorem is established giving a necessary and sufficient condition for this proposition to hold. For the special case of fixed size ratio, it is shown that the hypotheses of this general theorem are satisfied. Author

N65-25227# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SUPERFLUIDITY OF He^3
V. P. Peshkov 22 Dec. 1964 9 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 46, no. 4, 1964 p 1510–1513
(FTD-TT-64-1049/1+2+4; AD-610304)

Preliminary experiments designed to test the hypothesis that He^3 will become superfluid at sufficiently low temperatures are reported. Described is a device with a three-stage adiabatic demagnetization, which was used to obtain the lowest temperatures in He^3. Included are results of measurements of the parasitic heat flux, temperature, specific heat, and heat transfer of an empty pellet and of a pellet filled with He^3. Also considered is the effect of gamma irradiation from the test apparatus on changes in the curves of specific heat with temperature on empty and filled pellets. Previous theoretical studies of the superfluidity of He^3, its possible properties, and transition temperature are cited. S.C.W.

N65-25229# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
TABLES OF THE MIE FORWARD LOBE
C. W. Querfeld and W. A. Farone Ft. Monmouth, N. J., Army Electron. Command, May 1965 423 p refs
(ERDA-314; AD-463921)

Tables of the angular dependence of the perpendicular and parallel intensity factors are given for the Mie forward lobe. Real refractive indexes are used with m = 1.10, 1.15, 1.20(0.1)2.5, and in addition complex refractive indexes are used in which m = 2.00(1-iK), K = 0.05, 0.25, 0.5, 1.0, and 2.0. The forward lobe is computed for scatter angles θ = 0(1.0)30.0 for size parameters α = 1.0(1.0)20.0 for each refractive index. Extinction, absorption, scattering, and backscattering efficiency factors are computed as well as the ratios, sums, and phase angles of the intensity factors. Author

N65-25278# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
USE OF CONFORMAL MAPPING TO MODIFY THE FIELD OF AN ELECTROMAGNET
F. L. Fuller Oct. 1964 12 p refs
(RM-253)

When modification of the field in the air gap between the pole faces of an electromagnet is done by a small localized change in the pole surface by adding some material, the change in field may be calculated by superimposing a doublet on the surface. It is shown how conformal mapping may be used to determine both the shape of the modified pole face and the resulting field distribution. Formulas developed here were used in experiments on a large electromagnet. An account of these experiments is given. Author

N65-25279# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
DIGITAL COMPUTATION OF THE FIELD OF AN ELECTROMAGNET
F. J. Fuller Dec. 1964 17 p refs
(RM-254)

The nonlinear partial differential equation for the magnetostatic field with variable permeability is developed for the case in which the medium is discontinuous. These relations are converted to finite difference form and solved by means of a digital computer. The computer program is given and a sample problem is presented to illustrate the application of the method to a practical problem. Author

N65-25286# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
THE USE OF SUPERCONDUCTORS FOR GENERATION OF HIGH MAGNETIC FIELDS. PART I: MATERIALS CAPABLE OF SUPPORTING LARGE SUPERCURRENT DENSITIES
Samuel D. Lindenbaum Nov. 1964 53 p refs
(RE-194)

The use of superconductors for the generation of high magnetic fields, is primarily concerned with materials capable of supporting large supercurrent densities. The advantages in the use of superconducting magnets over conventional magnets are pointed out, with reference to specific examples. The historical development of superconductors with large current-carrying capacity in high magnetic fields, and their possible use for magnets, is traced from the time of the discovery of superconductivity in 1911 by Onnes up to the present. The physical bases for high-field superconductivity are discussed, and the distinguishing features of type I and type II superconductivity illustrated. Author

N65-25329# ARO, Inc., Arnold Air Force Station, Tenn.
10–22°K CRYOSORPTION OF HELIUM ON MOLECULAR SIEVE 5A AND HYDROGEN ON CONDENSED VAPORS
R. E. Southerlan Arnold Eng. Develop. Center, May 1965 34 p refs
(Contract AF 40(600)-1000)
(AEDC-TR-65-49; AD-463339)

Experimental results are presented for helium adsorption on molecular sieve 5A at 10° and 13.6° K. Results are also given which show that water frost near 22° K adsorbs hydrogen at high volumetric rates with significant adsorptive capacity. Carbon dioxide frosts demonstrated these characteristics to a lesser degree near 16° K. Author

N65-25356# Uppsala Univ. (Sweden).
THE INDEPENDENT-PARTICLE MODEL FOR MANY-ELECTRON SYSTEMS. I: COMPARISON OF DIFFERENT INDEPENDENT PARTICLE APPROXIMATIONS
Werner Kutzelnigg and Vedene H. Smith, Jr. 15 Jul. 1964 57 p refs *Its* Preprint No. 130
(Contract AF 61(052)-701)

Approximation of wave functions of quantum mechanical states by independent-particle models is considered theoretically. Three models, namely the criteria of best energy, best overlap, and best density, which are based on the general properties of the true wave function, are defined and compared. It was found that for those states where all three models produce good approximations, the models can lead to conflicting results. Since the independent-particle concept is only able to describe one-particle properties with sufficient accuracy, and since all one-particle properties are completely determined by the first-order density matrix, the scheme which is based on the best approximation of the first order density matrix defines, in general, the best independent-particle model. The best density model is the only one of the three which is linear, and has the additional virtue of leading with relative ease to the best energy orbitals as solutions of the Hartree–Fock equations. J.M.D.

N65-25357# Uppsala Univ. (Sweden).
LINEAR ALGEBRA AND THE FUNDAMENTS OF QUANTUM THEORY
Per-Olov Löwdin 1 Jul. 1964 84 p refs *Its* Preprint No. 125
(Contract AF 61(052)-701)
(TF-65)

It is investigated how far formulation of the fundaments of quantum theory can be made using the axioms of linear algebra alone, i.e., without the concept of the scalar product. Treating linear spaces of finite order, it is possible to formulate the eigenvalue problem for a linear operator and reach the concepts of matrix representation, eigenexpansions, and transformation to diagonal and classical canonical form. Further, concepts of projection operators, resolution of the identity, and spectral resolution of an operator can be defined. In treating infinite spaces, interest is confined to operators having all eigenvalues situated in a finite number of points in the complex plane, each of which may be infinitely degenerate. Assuming that the operator under consideration satisfies a reduced Cayley–Hamilton equation of finite order, the existence of a set of projection operators forming a resolution of the identity is demonstrated and used to carry out a unique component analysis of an arbitrary element of the space. Even the spectral resolution of the operator exists. In quantum theory, these theorems are of particular importance in treating constants of motion. Finally, the scalar product is introduced, and the connection with conventional approach studied. Author

N65-25389# European Space Research Organization, Paris (France).
VACUUM
J. H. Makkink [1965] 69 p
(P/751)

This lecture is a rather comprehensive review of basic vacuum technology from definition of terms to the measuring of pressures less than 10^{-7} torr. E.E.B.

N65-25407*# Space Technology Labs., Inc., Redondo Beach, Calif. Physical Electronics Lab.
HIGH VOLTAGE BREAKDOWN INITIATED BY PARTICLE IMPACT
J. C. Slattery, J. F. Friichtenicht, and D. O. Hansen Apr. 1965 9 p refs
(Contract NASw-936)
(NASA-CR-63185; STL-4158-6009-TU-000) CFSTI: HC $1.00/MF $0.50

Experiments are described which provide quantitative information on the particle initiated voltage breakdown hypothesis. The existence of a low energy limit for particles capable of initiating discharge was verified and measured. A definite polarity dependence was noted and the effects of applied voltage and electric field were observed qualitatively. The experiments do not directly verify the validity of the hypothesis but the particle parameters required to initiate breakdown can be determined by extending the measurements to higher voltages and fields where the particle impact hypothesis is presumed to be valid. R.N.A.

N65-25538# Stanford Univ., Calif. Linear Accelerator Center
MAGNETIC FIELD MEASUREMENT AND SPECTROSCOPY IN MULTIPOLE FIELDS
J. K. Cobb and J. J. Muray Feb. 1965 84 p refs
(Contract AT(04-3)-400)
(SLAC-39) CFSTI: $2.00

Magnetic field measurements in multipole magnetic fields used to measure magnetic field parameters in the strong focusing lenses for a linear accelerator are reviewed. The theory

and measurement processes for determining the magnetic center in multipoles, the length of the gradient fields, and the harmonic content in strong focusing lenses are described. The results of these accurate measurements are related to the optical parameters of the multipole lenses. A summary of the properties and field distribution of the lenses is included. R.N.A.

N65-25543# New York Univ., N. Y. AEC Computing and Applied Mathematics Center

ASYMPTOTIC WAVE FUNCTIONS FOR ATOMIC SYSTEMS

Lawrence Mendelsohn and Jerome Percus 30 Apr. 1965 64 p refs

(NYO-1480-20)

A technique for calculating wave functions for atoms and ions is developed. Formal asymptotic expansions with largeness parameter Z (nuclear charge) are determined through first order in $^1/_Z$. In so doing the Schrodinger equation for a general atomic system with N electrons is reduced to a set of first-order partial differential equations which are solved recursively. Screening and correlation are exhibited explicitly in the resulting asymptotic atomic wave functions. Applications made to the ground state of 2 electron systems show that the asymptotic wave function obeys the virial theorem through first order. Magnetic susceptibilities within 5% of the accepted values are obtained for helium and singly ionized lithium. Other expectation values, $1/2\langle s_1 + s_2\rangle$, $\langle s_{12}{}^2\rangle$, and $\langle s_{12}\rangle$ are found to be in excellent agreement with a variational calculation utilizing 1078 parameters. In determining the asymptotic wave function in regions about certain singular points by a "matching technique," ln Z/Z terms enter. The omission of such terms in ordinary variational-perturbation wave functions may result in a loss of accuracy when computing expectation values other than the energy. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N65-24434# Los Alamos Scientific Lab., N. Mex.

EVALUATED NEUTRON CROSS SECTIONS FOR TRITIUM

Leona Stewart Apr. 1965 60 p refs

(Contract W-7405-ENG-36)

(LA-3270) CFSTI: $3.00

A graphical interpretation of evaluated neutron cross sections for tritium and possible reaction mechanisms for incident neutrons below 20 MeV, is presented. Tabular and graphical results are presented for total and integral values of the cross sections for elastic scattering. Reaction Q values and threshold energies are listed for several cross sections. Measurements are included for the total cross section; elastic scattering; nonelastic scattering; capture; T(n,d)2n *or* σn,2n; T(n,p)3n or σn,3n; and emission (all neutrons except elastic). S.C.W.

N65-24462# Oak Ridge National Lab., Tenn. Radiation Shielding Information Center

TABULATED VALUES OF SCATTERED GAMMA-RAY FLUXES IN IRON INTERPOLATED FROM MOMENTS-METHOD CALCULATIONS

D. K. Trubey May 1965 85 p refs

(Contract W-7405-ENG-26)

(ORNL-RSIC-7)

Tables of scattered gamma-ray fluxes in iron that are suitable for integration over source spectra were generated on the IBM-7090 computer by Lagrangian interpolation of Goldstein–Wilkins moments-method results for point isotropic gamma-ray sources. Values of the fluxes were obtained for a consistent set of scattered gamma-ray energies taken in steps of 0.1 MeV from 0.2 to 1.0 MeV and in steps of 0.25 MeV from 0.25 to 10 MeV. One table was obtained for each scattered energy for various values of the source energy and of the distance from the source in mean free paths. Tables were then generated in which the distance from the source was converted from mean free paths to centimeters. The latter set may be integrated over any source spectrum to obtain the flux of scattered gamma rays in iron and, with small error, in any material in which the cross section is similar. Author

N65-24500# Israel Program for Scientific Translations, Ltd., Jerusalem.

PHYSICS OF NUCLEAR FISSION

N. A. Perfilov and V. P. Eismont, ed. 1964 217 p refs Transl. into ENGLISH of the book "Fizika Deleniya Atomnykh Yader" Moscow, Gosatomizdat 1962 Published for AEC and NSF

(AEC-TR-6205)

CONTENTS:

1. THE ASYMMETRY IN THE MASS DISTRIBUTION OF FISSION FRAGMENTS: THEORETICAL REVIEW B. T. Geilikman p 1–7 refs (See N65-24501 14-04)

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18. ASYMMETRY AND ANISOTROPY OF FISSION IN URANIUM AND BISMUTH INDUCED BY 660 MeV PROTONS A. I. Obukhov p 188–195 refs (See N65-24518 14-32)

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20. THE FISSION OF HEAVY NUCLEI IN NATURE A. K. Lavrukhina p 201–210 refs (See N65-24520 14-27)

N65-24501 Israel Program for Scientific Translations, Ltd., Jerusalem.

THE ASYMMETRY IN THE MASS DISTRIBUTION OF FISSION FRAGMENTS: THEORETICAL REVIEW

B. T. Geilikman *In its* Phys. of Nucl. Fission 1964 p 1–7 refs (See N65-24500 14-24)

The literature on the asymmetry of nuclear fission is reviewed. Explanations of this asymmetry derived from the liquid drop model are discussed in connection with the statistical model and the importance of shell effects at low energies. Also, a qualitative explanation of fission asymmetry using the single-particle model shows that fissioning nuclei have an asymmetric form near the saddle point. The cause for the appearance of asymmetric deformations long before the neck's rupture point was indicated. The calculations of the position of the 1^- levels for a number of equilibrium nuclei and the values of the fission barriers for asymmetric forms of fissioning nuclei are in good agreement with the experimental data. Further, the asymmetric deformation parameter at the saddle point depends linearly on the experimental value of the most probable mass ratio of the fragments for a number of nuclei. This model, however, requires quantitative refinements. In particular, it does not take into account the effects of pair correlation, which may change the position of the single-particle levels. E.E.B.

N65-24502 Israel Program for Scientific Translations, Ltd., Jerusalem.

STATISTICAL FISSION THEORY

G. A. Pik-Pichak and V. M. Strutinskii *In its* Phys. of Nucl. Fission 1964 p 8–18 refs (See N65-24500 14-24)

In the fission process when the fissioning nucleus is highly excited, it has been assumed that during deformation the energy exchange between the various degrees of freedom will take place relatively rapidly compared with the deformation rate. Fission properties, such as the charge and mass distributions, the fluctuations in the kinetic energy of the fragments and in the total kinetic energy, are then determined by the statistical weights of the corresponding states at the moment of separation of the fragments. In order to determine the statistical weights, the potential energy of the fissioning nucleus before neck rupture must be calculated using the semiempirical formula for the mass of the nucleus, generalized to the case of a deformed nucleus. The results of these calculations are given. Also, the traditional formula for the mass of a nucleus with atomic number Z and number of nucleons A is discussed. Further, the method of touching fragments used to determine the potential energy of the nucleus at the moment of rupture is reviewed. Expressions for the probability of fission with a given mass ratio of the fragments and for the fluctuation of the total kinetic energy in the statistical model are given. E.E.B.

N65-24503 Israel Program for Scientific Translations, Ltd., Jerusalem.

FISSION ASYMMETRY

A. N. Protopopov *In its* Phys. of Nucl. Fission 1964 p 19–39 refs (See N65-24500 14-24)

The basic features of asymmetric and symmetric fission are discussed, and the results of the most important experimental investigations of the mass distributions in the fission of heavy elements by various particles of low and intermediate energies are presented. It is noted that asymmetric fission is a relatively slow process during which the shell structure of the unseparated fragments is formed. Symmetric fission is probably a fast process in which the highly excited compound nucleus undergoes fission without a preliminary emission of neutrons. Asymmetric fission is the dominating process in the transthorium elements at excitation energies from 0 to about 40 MeV. At an excitation energy of about 40 MeV, the relative probabilities of both types of fission are approximately equal. The probability of symmetric fission in the transthorium elements increases with excitation above 40 MeV. It is also noted that as a result of octopole deformations of the nucleus, the transthorium elements have a pearlike form at the saddle point, resulting in asymmetric fission. The symmetric fission at the saddle point is characteristic of nuclei having a value of $Z^2/A \leq 34.3$. E.E.B.

N65-24504 Israel Program for Scientific Translations, Ltd., Jerusalem.

RADIOCHEMICAL INVESTIGATION OF THE FISSION OF Am^{241} BY NEUTRONS OF DIFFERENT ENERGIES

N. I. Borisova, B. V. Kurchatov, V. I. Novgorodtseva, V. A. Pchelin, L. V. Chistyakov et al. *In its* Phys. of Nucl. Fission 1964 p 40–44 refs (See N65-24500 14-24)

Experimental procedure and results are given for the fission of Am^{241} by neutrons of different energies. Results showed that the relative yields of the corresponding fragments in the fission by thermal neutrons and by neutrons in the first resonance (0.3 eV) were equal within the limits of experimental error. However, for Sn^{121}, which is the most sensitive indicator of symmetric fission, the experimental error reached 60% of the value of the yield found for the resonance fission, due to the accumulation of errors and the substraction of two quantities with similar values. Therefore, it was only possible to note that there was no large difference between the fractions of symmetric fission in both cases. Further, the mass yield curve for the fission of Am^{241} by thermal neutrons is given. Its main feature is the deeper minimum (almost four times deeper) compared with that of the curve for Pu^{239}. It was observed that this is probably connected with the subthreshold fission mechanism. Also, the points for Sn^{125} lie appreciably lower than the curve. This is an indication of the formation of a 9.5-minute isomer of Sn^{125} with a yield of the same order of magnitude as the yield of the 9.6-day Sn^{125}. E.E.B.

N65-24505 Israel Program for Scientific Translations, Ltd., Jerusalem.
NUCLEAR FISSION AND THE ANGULAR ANISOTROPY OF THE FRAGMENTS
V. M. Strutinskii *In its* Phys. of Nucl. Fission 1964 p 45–50 (See N65-24500 14-24)

When fast particles are captured, a compound nucleus is formed whose angular momentum has a certain orientation with respect to the incident beam. The rotation energy of the nucleus depends on the mutual orientation of the fission axis and the angular momentum of the compound nucleus. The anisotropy of the angular distribution of the fission fragments is discussed as a dependency of this compound nucleus concept. Also, it was observed that the absence of a relation between the parity of the compound nucleus and the parity of the spin in the states K = 0, as well as the absence of any systematic relation between the fission asymmetry and the quantum characteristics of the compound nucleus may be considered as evidence for the optical model. E.E.B.

N65-24506 Israel Program for Scientific Translations, Ltd., Jerusalem.
ANGULAR FISSION ANISOTROPY
V. P. Eismont *In its* Phys. of Nucl. Fission 1964 p 51–83 refs (See N65-24500 14-24)

The literature on the angular fission anisotropy is reviewed. Also, the dependence of the anisotropy on the properties of the target nucleus and of the incident particle are discussed in detail. Photofission, thermal neutron, fast neutron, charged particle, heavy ion, and high-energy particle fission are considered. Further, the dependence of the anisotropy on the mass of the fission fragments is considered. Finally, a list of papers containing experimental data on the angular distribution of fission fragments, theoretical analyses of the angular features of fission, and reviews of the experimental and theoretical results are included. E.E.B.

N65-24507 Israel Program for Scientific Translations, Ltd., Jerusalem.
PROMPT FISSION NEUTRONS AND Γ-RAYS
Yu. S. Zamyatnin *In its* Phys. of Nucl. Fission 1964 p 84–104 refs (See N65-24500 14-24)

The experimental data obtained in the study of fission neutrons and gamma rays are reviewed. Also, a number of problems in the formation of excited fragments and in the emission of neutrons and gamma rays by them are listed. The reason for the discrepancy between the calculated and experimental values for the excitation energy carried away by the gamma rays remains unclear. In this connection it was considered interesting to study the lifetime of the gamma radiation of the fission fragments for times less than 10^{-9} seconds, which will elucidate the competition between the gamma radiation and the evaporation of the neutrons. Also, the study of the angular anisotropy of fission gamma rays may give information on the magnitude and direction of the angular momentum of the fragments. Further, there are no data on the distribution of the excitation energy between the fragments at higher excitation energies of the fissioning nucleus, and the problem of the energy balance in symmetric fission and of the fraction of this energy carried away by particles and gamma quanta also ren ains unsolved. E.E.B.

N65-24508 Israel Program for Scientific Translations, Ltd., Jerusalem.
THE SPECTRA AND AVERAGE NUMBER OF NEUTRONS IN THE FISSION OF Th^{232} AND U^{233} BY 14.3 MeV NEUTRONS
Yu. A. Vasil'ev, Yu. S. Zamyatnin, E. I. Sirotinin, P. V. Toropov, E. F. Fomushkin et al *In its* Phys. of Nucl. Fission 1964 p 105–109 refs (See N65-24500 14-24)

The neutron spectra in the fission of Th^{232}, U^{233}, and U^{235} was determined in the energy range 0.3 to 5 MeV by the time-of-flight method, using a pulsed source of primary neutrons. A counting rate from 50 neutron/hr for Th^{232} to 350 neutron/hr for U^{235} was reported. The time resolution, determined from the line width of the primary fission neutrons and prompt gamma rays, was from 7 to 8 nanoseconds. Also, the average number of fission neutrons was found to be 4.11 ±0.30 for U^{235}; 3.68 ±0.25 for Th^{232}; and 4.20 ±0.30 for U^{233}. The values for U^{235} and U^{233} agreed with previous measurements; however, the value for Th^{232} differed significantly from two previous values. E.E.B.

N65-24509 Israel Program for Scientific Translations, Ltd., Jerusalem.
COMPARISON OF THE SPECTRA OF PROMPT NEUTRONS IN THE SPONTANEOUS FISSION OF Pu^{240} AND IN THE INDUCED FISSION OF Pu^{239}
V. I. Bol'shov, L. D. Gordeeva, V. F. Kuznetsov, and G. N. Smirenkin *In its* Phys. of Nucl. Fission 1964 p 110–115 refs (See N65-24500 14-24)

The prompt neutron spectra in the spontaneous fission of Pu^{240} and in the induced fission of Pu^{239} by slow neutrons are compared. The difference in the excitation energies of the compound nucleus amounted to 6.3 MeV. The spectra were measured by a fast-neutron single-crystal scintillation spectrometer, using stilbene with a compensation of the gamma ray pulses. The pulse from the compensation channel was applied to the discriminator whose output controlled the operation of the analyzer in such a manner that the linear channel pulse was analyzed only when it corresponded to the neutron pulse. Plutonium oxide served as the spontaneous neutron source of the fission of Pu^{240}. The best fit of the experimental data to the calculated curves was for an effective temperature of 1.24 MeV for the spontaneous fission of Pu^{240} and 1.44 MeV for the induced fission of Pu^{239}. There were no data available in the literature on the spontaneous fission spectra of Pu^{240}. The values previously published for the neutron-induced fission spectrum of Pu^{239} vary within wide limits from 1.25 to 1.52 MeV. E.E.B.

N65-24510 Israel Program for Scientific Translations, Ltd., Jerusalem.
SPONTANEOUS NUCLEAR FISSION
V. A. Druin and G. N. Flerov *In its* Phys. of Nucl. Fission 1964 p 116–124 refs (See N65-24500 14-24)

The instability of heavy nuclei with respect to spontaneous fission is discussed, and the literature on the subject is reviewed. Measurements made on the spontaneous fission of the plutonium isotopes gave values of 5.2×10^{10} years for Pu^{238} and 6.7×10^{10} years for Pu^{242}. Also, the reaction $Pu^{242}(O^{16}, 4n)\ 102^{254}$ is discussed. It was shown that the cross section for this reaction did not exceed 10^{-32} sq cm. It is also observed that this value was less than 0.01 of the cross section for the formation of the same isotope by the reaction $Cm^{246}(C^{12}, 4n)102^{254}$. The difference between the cross sections obtained for element 102^{254} in these experiments and those made by previous workers may be because in the previous experiments the effect of spontaneous fission observed was connected with the formation of heavier isotopes of element 102, since the curium target had a complex isotopic composition with 0.02% of Cm^{248}. The formation in the reaction (C^{12}, 4n) on this curium isotope of 102^{256} is probable since it is situated immediately beyond the subshell of the 152nd neutron where a sharp increase in the spontaneous fission rate is observed. E.E.B.

N65-24511 Israel Program for Scientific Translations, Ltd., Jerusalem.

LONG-RANGE α-PARTICLES IN THE SPONTANEOUS FISSION OF THE TRANSURANIUM ELEMENTS

N. A. Perfilov, Z. I. Solov'eva, R. A. Filov, and G. I. Khlebnikov *In its* Phys. of Nucl. Fission 1964 p 125–129 refs (See N65-24500 14-24)

The spontaneous fission of Cm^{242} ($T_f = 7.2 \times 10^6$ yrs) and Pu^{240} ($T_f = 1.2 \times 10^{11}$yrs) was investigated. The Pu^{240} was in a mixture of isotopes of known composition. Solutions containing the salts of the isotopes were subjected to chromatographical purification in columns of anion-exchange and cation-exchange resins, after which the isotopes were electrolytically deposited on platinum substrates. The energy distribution of the alpha particles of the spontaneous fission of Cm^{242} and Pu^{240} is shown. For curium the maximum of the curve was at 15.5 ±1.0 MeV, and for plutonium the maximum was at 17.0 ±0.5 MeV. The total number of particles in the spectrum obtained by extrapolation gave a higher probability of complex fission of 1:280 ±50 for Cm^{242} and 1:400 ±60 for Pu^{240}. The results are compared with published results on Cf^{252}. The solution of the problem of complex spontaneous fission of transuranium elements requires a larger number of experimental facts for different elements and for various isotopes of the same element. Alpha particles of the complex spontaneous fission of Pu^{238} were also observed; however, the statistics available do not permit an analysis of the process. E.E.B.

N65-24512 Israel Program for Scientific Translations, Ltd., Jerusalem.

ENERGY RELATIONS IN THE TRIPLE FISSION OF URANIUM

V. N. Dmitriev, L. V. Drapchinskii, K. A. Petrzhak, and Yu. F. Romanov *In its* Phys. of Nucl. Fission 1964 p 130–133 refs (See N65-24500 14-24)

The energy distribution of the fragments of the triple fission of U^{233} was investigated. About 8000 triple fission and 10000 double fission events were recorded. The most probable total energies of double and triple fission were found to differ by 16 ±1 MeV. Also, the difference between the most probable total fragment energies in double and triple fission, for various ratios was constant within the limits of experimental error, and was about 16 MeV. Further, it is shown that the maximum of the distributions of the fragments of various masses occurs approximately at the same ratio, their half-widths are the same, and the peak-to-trough ratios are equal. Thus, the mass distributions of the fragments in triple fission are similar to those in double fission. This was also observed in the triple fission of U^{235}. Since the results of this investigation showed that triple and double fission have a number of similar characteristics, it was assumed that the emission of alpha particles occurs in the last moment of the fission event after the fragments were formed. E.E.B.

N65-24513 Israel Program for Scientific Translations, Ltd., Jerusalem.

NEUTRON SPECTROMETRY OF FISSIONING NUCLEI

M. I. Pevzner *In its* Phys. of Nucl. Fission 1964 p 134–142 refs (See N65-24500 14-24)

The fission of heavy nuclei by slow and resonance neutrons is discussed; experimental data are reviewed; and these data are interpreted. Further, an analysis is presented for the cross sections of Pu^{239}, U^{233}, U^{235}, and Pu^{241}. The available data agree with the assumption that two groups of fission resonances exist, which have different average widths. The narrow resonances are connected with a small number of fission channels and interfere appreciably with each other. The wide resonances, not interfering with each other and with the narrow resonances, are mainly displayed in the large thermal cross section obeying the 1/v law. The number of secondary neutrons per single primary neutron absorbed by a fissionable isotope has the maximum value in the thermal range and between clearly displayed resonances, and falls off in the region of the narrow resonances. E.E.B.

N65-24514 Israel Program for Scientific Translations, Ltd., Jerusalem.

NUCLEAR FISSION AT AN EXCITATION ENERGY OF 20–100 MeV

G. A. Pik-Pichak *In its* Phys. of Nucl. Fission 1964 p 143–150 refs (See N65-24500 14-24)

The dependence of the fission probability by alpha particles on the excitation energy and on the angular momentum in the region of lead was investigated. In contrast to light bombarding particles (p, n, d), when the bombardment is carried out by alpha particles with an energy of 40 MeV, a compound nucleus is generally formed, of which the capture cross section can be determined and the angular momentum is not large enough to change the fission probability appreciably. Further, since the fission probability is strongly dependent on the excitation energy, the fission actually lasts until the escape of the first neutron (the contribution from fission after the escape of the neutron is smaller than 10%). Graphs showing the ratio of fission cross section to capture cross section as a function of the excitation energy are given for Bi^{209}, Pb^{206}, Pb^{207}, Pb^{208}, and Au^{197}. Also, the fission of nuclei in reactions with heavy ions was considered. E.E.B.

N65-24515 Israel Program for Scientific Translations, Ltd., Jerusalem.

NUCLEAR FISSION BY HIGH-ENERGY PARTICLES

N. A. Perfilov *In its* Phys. of Nucl. Fission 1964 p 151–174 refs (See N65-24500 14-24)

Fission events in the excitation of nuclei by particles with energies of tens and hundreds of MeV are considered. The effect of the excitation energy of the nucleus before fission on the mass distribution of the fission products, the cross sections, and fissionabilities of different nuclei, and the relation between competing processes when the nucleus is cooling down are examined. From the extensive experimental material considered, the following were among the conclusions presented. As the excitation energy rises, the mass distribution indicates an increase at first in the probability of symmetric fission and then a broadening of the mass distribution curve with a decrease in the observed fraction of symmetric fission. The asymmetric mass distribution, which is typical of low energies and is possibly due to shell effects, is observed in the fission of nuclei with an atomic number greater than 90 and radium, as well as in the fission of bismuth. Nuclear fissionabilities increase with excitation energy up to a certain value which is determined by the atomic number, and then do not depend, or depend only weakly, on the energy. E.E.B.

N65-24516 Israel Program for Scientific Translations, Ltd., Jerusalem.

SOME RESULTS ON THE INTERACTION OF FAST PROTONS WITH HEAVY NUCLEI WITH REFERENCE TO THE FISSION PROCESS

B. N. Belyaev and A. N. Murin *In its* Phys. of Nucl. Fission 1964 p 175–181 refs (See N65-24500 14-24)

The momentum distributions of the residual nuclei in the bombardment of Bi209 by 135 MeV protons using the cascade-evaporation model were calculated. Also, the fission cross section was calculated for Bi^{209} by 145 MeV proton bombardment. A value of 95 ±13 mb was obtained which is in satisfactory agreement with the 80-mb value from the radiochemical method and with 125 mb determined by an ionization chamber. The average excitation energy was found to be 112 MeV for the fissioning nuclei after the cascade, and the most probable excitation energy lies in the range of 110 to 120 MeV. Further, the calculations indicated that the sum of the mass numbers of the most probable products formed after the fission and the emission of neutrons by the fragments was in the range 199 to 198 amu. This result is very near the experimental figure of about 196 amu. Calculations also showed that nuclei with mass numbers in the range 198 to 204 amu undergo fission, and that approximately 60% fissions are neutron-deficient Po isotopes of 199 to 202 amu. E.E.B.

N65-24517 Israel Program for Scientific Translations, Ltd., Jerusalem.

THE RADIOCHEMICAL STUDY OF THE ISOTOPES OF THE RARE-EARTH ELEMENTS FORMED IN THE PHOTO-FISSION OF URANIUM

A. K. Lavrukhina, V. I. Gol'danskii, G. M. Kolesov, E. V. Minarik, and T'ang Hsiao-eng *In its* Phys. of Nucl. Fission 1964 p 182–187 refs (See N65-24500 14-24)

The results of a radiochemical study of the radioisotopes of the rare-earth elements formed in the fission of natural uranium by gamma quanta having a bremsstrahlung spectrum with a maximum energy of 100 to 250 MeV are reported. The half-life and the relative yield of 25 identified radioisotopes of these elements are tabulated. In the photofission of uranium by gamma quanta with a maximum energy of 100 to 250 MeV, only isotopes of the rare-earth elements and yttrium with excess neutrons are formed. This is also characteristic of the fission of U^{235} by thermal neutrons. Also, as the energy of the gamma quanta was increased, an increase in the relative yields of the identified rare-earth elements was observed. Thus, the yield of La^{140}, Pr^{143}, Pr^{145}, Pm^{148}, and Sm^{156} increases by a factor of 3 or more when the maximum energy of the gamma quanta varies from 100 to 250 MeV. Of particular interest was the screened La^{140}, Pm^{148}, and Pm^{150} isobars which are tabulated with data on screened Ag^{112} and Br^{82} isobars. E.E.B.

N65-24518 Israel Program for Scientific Translations, Ltd., Jerusalem.

ASYMMETRY AND ANISOTROPY OF FISSION IN URANIUM AND BISMUTH INDUCED BY 660 MeV PROTONS

A. I. Obukhov *In its* Phys. of Nucl. Fission 1964 p 188–195 refs (See N65-24500 14-24)

The results obtained by the nuclear emulsion method of the fission asymmetry and anisotropy when uranium and bismuth were irradiated by 660 MeV protons are presented. Also, calculations of the angular momenta received by the nucleus when interacting with a proton are given. The average value of the angular momentum of the nucleus after the cascade is only a part of the average orbital momentum carried by the proton. The data indicated that there is a wide range of orientations of the momenta. Because of the disorientation of the angular momentum of the nuclei as a result of the cascade and because of the high excitation energy at the moment of the fission, the angular distribution of the fission fragments is almost isotropic. The ratios of the number of longer-range fragments in the front hemisphere to their number in the rear hemisphere for some range-asymmetry intervals for uranium bombarded by 660 MeV protons are also given. Further, the values of these ratios were also calculated assuming equal escape probabilities of the fragments to the front and rear hemispheres in the center-of-mass system. The experimental values fit the calculated ones to within the limits of experimental error. E.E.B.

N65-24519 Israel Program for Scientific Translations, Ltd., Jerusalem.

RANGE CHARACTERISTICS IN PROTON-INDUCED FISSION OF LEAD NUCLEI

V. F. Darovskikh *In its* Phys. of Nucl. Fission 1964 p 196–200 refs (See N65-24500 14-24)

The dependence of the kinetic energy and the fragment yields on the degree of asymmetry in the fission of lead by high-energy particles was investigated. Curves of the dependence of the mean total range on the ratio of ranges of the light and heavy fission fragments indicated that for range ratios from 1.00 to 2.00 the mean total range attains maximum twice at ratios of 1.25 and 1.60. Consequently, at these range ratios the mean total kinetic energy of the fission fragments passes through a maximum. Also, similar relations exist for bismuth. Further, in order to estimate the effects of the translational velocity of the compound nucleus on the results, the dependence of the mean total range on the range ratio for two different variants was constructed. It was observed that the translational velocity does not significantly affect the characteristics considered. Also, histograms of the distribution of the fission of lead over the range ratio showed that, for events associated with the escape of a small number of charged particles, the fission was symmetric. For events with 4 and 5 escaped charged particles, in addition to symmetric fission, asymmetric fission was observed. E.E.B.

N65-24520 Israel Program for Scientific Translations, Ltd., Jerusalem.

THE FISSION OF HEAVY NUCLEI IN NATURE

A. K. Lavrukhina *In its* Phys. of Nucl. Fission 1964 p 201–210 refs (See N65-24500 14-24)

The likelihood that the fission of uranium and the transuranium nuclei contributes to the present abundance of the isotopes of the rare-earth elements was investigated. Due to the great similarity of their chemical properties, these elements are not subjected to appreciable fractionation throughout the entire evolution of such cosmic bodies as the earth and the meteorites. This is indicated by the data on the relative abundance of these elements in the earth's crust and in chondrites. The characteristic features of the isotopic composition of the rare earths; the variations due to radioactive decay, to the spontaneous fission of Cf^{254} and other transthorium elements, to thermal neutron fission of U^{235} and the isotopes of the transuranium elements; and the high-energy proton fission of uranium are discussed. Facts are presented to show the important role of the nuclear processes caused by cosmic rays in the evolution of matter in space. E.E.B.

N65-24531 Joint Publications Research Service, Washington, D. C.

COHERENT BREMSSTRAHLUNG OF EXTENDED ELECTRON CLUSTERS

G. A. Alekseyev and P. B. Bliokh *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 61–74 refs (See N65-24525 14-07) CFSTI: $7.00

Bremsstrahlung is analyzed for the case of electron clusters of arbitrary shape and dimensions. It is shown that for point of observation there exists a surface on which the charge radiates coherently toward that point. The directional distribution of radiated power is calculated for a sequence of electron clusters shaped in the form of a parallelopiped. Author

N65-24532 Joint Publications Research Service, Washington, D. C.

ON THE THEORY OF MOLECULAR GENERATOR FLUCTUATIONS

V. B. Tsaregradskiy *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 75–94 refs (See N65-24525 14-07) CFSTI: $7.00

The effect of thermal and shot fluctuations on the molecular generator oscillations is analyzed on the basis of the averaged polarization vector equations. The spectral densities of amplitude and frequency fluctuations are found. It is shown that the high degree of stability and monochromaticity of the molecular generator oscillations can be explained by the self-regulating action of the phase difference between field and the polarization. Author

N65-24535 Joint Publications Research Service, Washington, D. C.

ENERGY SPECTRUM 2^3S_1 OF THE He^3 STATE IN AN ARBITRARY FIELD

G. V. Skrotskiy and V. G. Pokazan'yev *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 118–125 refs (See N65-24525 14-07) CFSTI: $7.00

The energy spectrum of the basic metastable He^3 state is analyzed. The frequencies of transition between the sublevels of the basic state are calculated for the case where an external magnetic field is present; special consideration is given to the case of a weak field. Author

N65-24536 Joint Publications Research Service, Washington, D. C.

THEORY OF OPTICAL ORIENTATION IN He^3

G. V. Skrotskiy and V. G. Pokazan'yev *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 126–139 refs (See N65-24525 14-07) CFSTI: $7.00

The possibility of optical orientation in He^3 is discussed. The relative probabilities of the transition between the 2^3S_1 and $2^3P_{0,1,2}$ levels of orthohelium induced by light of resonance frequency are computed. The signals and magnetic intensity of the optical oriented helium atoms are computed for both unpolarized and polarized light propagating along the direction of the magnetic field. Author

N65-24547 Joint Publications Research Service, Washington, D. C.

ON THE EFFECT OF RADIATION ON THE RESONANCE ACCELERATION OF A PARTICLE IN A PLANE-WAVE FIELD

V. B. Krasovitskiy and V. I. Kurilko *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 242–245 refs (See N65-24525 14-07) CFSTI: $7.00

Presented is a theoretical analysis of the effect of radiation on the acceleration of a particle under self-resonance conditions, and an analysis of an infinite number of nonrelativistic particles arranged periodically on a distance equal to the wavelength and rotating in phase. Using the equations of motion, it is shown that the effect of radiation of relativistic particles is reduced chiefly to the phase shifting of particle velocity in relation to the field and to a disturbance of the synchronism, and that maximum attainable energy is not dependent on the energy at which the acceleration began. It is further shown that during the motion of charged particle clusters as the result of coherent radiation, there is a slight change in bremsstrahlung forces, since the radiation cone of each cluster weakly captures the adjacent clusters, in contrast to the Cerenkov effect. It is concluded that the mutual effect of the particles on each other is smaller than in the nonrelativistic case since the radiation cone narrows with the increase in energy. S.C.W.

N65-24552 Joint Publications Research Service, Washington, D. C.

THE FORM OF A SEQUENCE OF SPIN ECHOES WHEN USING PULSES NOT SATISFYING THE CONDITION OF A 180° TURN

Yu M. Gryaznov and A. A. Chastov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 265–267 refs (See N65-24525 14-07) CFSTI: $7.00

An analysis of the form of a sequence of spin echoes, obtained when using pulses not satisfying the condition $\gamma H_1 \Delta t = \pi$, where H_1 is the intensity of a high frequency field, γ the gyromagnetic ratio, and Δt the duration of the pulse, is presented. It is assumed that the effect of relaxation processes during the passage of a sequence of pulses may be neglected. S.C.W.

N65-24608# Atomic Weapons Research Establishment, Aldermaston (England).

ON THE SOLUTION OF CERTAIN NEUTRONICS PROBLEMS BY WAY OF A SUITABLE ADJOINT PROBLEM

E. D. Pendlebury Oct. 1964 18 p refs (AWRE-O-52/64)

Some neutronics problems can most conveniently be solved by solving a suitable adjoint problem, saving machine time. In many practical cases machine time may be reduced by a factor of order 10. Types of problem which can usefully be solved in this way are discussed, together with the method of choosing the appropriate adjoint problem. Author

N65-24609# Atomic Weapons Research Establishment, Aldermaston (England).

NEUTRON CROSS SECTIONS OF NATURAL TITANIUM IN THE ENERGY RANGE 0.001 eV–18 MeV—INCORPORATION OF UNITED NUCLEAR CORPORATION DATA IN THE UKAEA NUCLEAR DATA LIBRARY

Susan M. Miller and K. Parker Oct. 1964 55 p refs (AWRE-O-77/64)

Energy and angular distributions of secondary neutrons from elastic scattering and the (n,n') and (n,2n) processes are given so that the data are complete for neutronics calculations. Author

N65-24610# Atomic Weapons Research Establishment, Aldermaston (England).

NEUTRON CROSS SECTIONS OF Pu-240 IN THE ENERGY RANGE 1 KeV TO 15 MeV

A. C. Douglas Jan. 1965 74 p refs (AWRE-O-91/64)

Recommended values are given for the neutron total and partial cross sections of Pu^{240} in the energy range 1 keV to

15 MeV. The scant experimental evidence is surveyed and supplemented by estimates based on nuclear theory. Details of energy and angular distributions are given so that the data are complete for the purpose of neutronics calculations. Author

N65-24611# Atomic Weapons Research Establishment, Aldermaston (England).
NEUTRON CROSS SECTIONS OF Pu-241 IN THE ENERGY RANGE 1 KeV TO 15 MeV
A. C. Douglas Feb. 1965 64 p refs
(AWRE-O-101/64)

Recommended values are given for the neutron total and partial cross sections of Pu^{241} in the energy range 1 keV to 15 MeV. The scant experimental evidence is surveyed and supplemented by estimates based on nuclear theory. Details of energy and angular distributions are given so that the data are complete for the purpose of neutronics calculations. Author

N65-24620# Smithsonian Astrophysical Observatory, Cambridge, Mass.
THE DETERMINATION OF OSCILLATOR STRENGTHS IN ATOMIC SPECTRA. DETERMINATION OF OSCILLATOR STRENGTHS IN THE SPECTRA OF IRON AND NICKEL
N. P. Penkin and G. F. Parchevskii Jun. 1964 103 p refs Transl. into ENGLISH from J. Quant. Spectrosc. Radiat. Transfer, v. 4, no. 41, 1964 and Vestn. Leningr. Univ. (USSR), v. 11, no. 113, 1954

This paper discusses methods for determining absolute and relative oscillator strengths of atomic spectral lines, with special attention to the hook method developed by D. S. Rozhdestvenskii. A new method for determining f-values, based on the simultaneous measurement of dispersion and total absorption in the spectral lines, is described. The paper summarizes results of measurements on absolute and relative oscillator strengths for lines in the spectra of elements belonging to groups I, II, and III of the Mendeleev table and of elements characterized by the building up of the third shell. Results obtained with the aid of the hook method in a study of the processes of excitation and ionization in a low-pressure plasma ($P \leq 10$ mm Hg) are also given. Author

N65-24624# Atomic Energy Commission, Washington, D. C. Div. of Technical Information
MICROSTRUCTURE OF MATTER
Clifford E. Swartz (State Univ. of N. Y.) Apr. 1965 64 p refs

This booklet on the microstructure of matter is one of a series entitled "Understanding the Atom" and is designed to acquaint the layman with the contemporary and future role of nuclear energy. Data on the nature of particles, particle forces and interactions, laws relating to particle conservation, and the organizational scheme of particles are presented. Also included are a review of instrumentation used in observing particles, a list of particle groups, and a review of particle nomenclature. S.C.W.

N65-24629# National Lead Co. of Ohio, Cincinnati. Feed Materials Production Center
ABSORPTION CORRECTION TABLES FOR MICROPROBE ANALYSIS: EFFECT OF CRITICAL EXCITATION POTENTIAL
J. W. Colby 7 May 1965 16 p refs
(Contract AT(30-1)-1156)
(NLCO-944) CFSTI: $1.00

New tables were prepared which, when used with earlier tables permit the effect of overvoltage to be easily taken into account. They may be used with any commercially available microprobe having a fixed X-ray emergence angle and any accelerating voltage up to 40 kV. Author

N65-24751# North American Aviation, Inc., Downey, Calif. Technical Information Center
MEASUREMENT OF THE GAMMA-RAY SPECTRA DUE TO NEUTRON CAPTURE IN CERTAIN MINERALS
A. A. Fedorov, M. M. Sokolov, and A. P. Ochkur 5 Feb. 1964 11 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 8, 1960 p 555–556
(SID-64-397; AD-459261)

Irradiation of the nuclei of chemical elements by thermal neutrons gives rise to gamma radiation with a spectrum of characteristic gamma lines for each nucleus. An analysis of such a gamma-ray spectrum accompanying neutron capture sometimes permits a judgement concerning the presence of certain elements in substances of complex chemical composition. Experiments performed in a bore hole confirmed the possibility of using this method to detect certain chemical elements in minerals. Author

N65-24812# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM Progress Report
Albert V. Crewe and Stephen Lawroski Apr. 1965 78 p refs
(Contract W-31-109-ENG-38)
(ANL-7045) CFSTI: $3.00

Significant technical progress of specific reactor projects and the general engineering research and development programs is presented: (1) Liquid Metal Cooled Reactors—Restricted fuel handling was performed to load one core-type subassembly and one inner blanket-type enriched subassembly into the storage blanket. The EBR II reactor is currently operating at 45 MW, and power operation is continuing to attain about 0.65 at.% burnup. (2) General Reactor Technology—No substantial error was found to exist in the fission rate determination between calculated and measured values of the ratio $\bar{\sigma}_c^{238}/\bar{\sigma}_f^{235}$. (3) Advanced Systems Research and Development—Calculations were made to estimate a loading of boron–stainless-steel poison strips for the two-thirds loading of 810 fuel foils with results showing that, with 400 g of natural boron in the core, the available excess reactivity controlled by the control blades will be approximately 4%. (4) Nuclear Safety—The electrical resistance of the test element was measured as a function of temperature from 70° to 1700° F. It was determined that the elements used as a resistance thermometer would not be accurate, therefore thermocouples were used for temperature measurement. R.W.H.

N65-24835# Army Missile Command, Huntsville, Ala. Physical Sciences Lab.
TEMPERATURE DEPENDENCE OF PURE NUCLEAR QUADRUPOLE RELAXATION IN Sn_4
Alfred C. Daniel 6 Jul. 1964 110 p refs
(RR-TR-64-8; AD-462204)

Pure nuclear quadrupole spin-lattice relaxation times for iodine^{127} in SnI_4 were measured from 4.2° to 300° K near 208 and 416 Mc/s, the observable transitions between the three energy levels resulting from the spin 5/2 of the iodine nuclei. Spin-echo apparatus used is described. From the solution of the rate equation the transition probabilities, W_1 and W_2 corresponding to the $m = \pm 1$ and $m = \pm 2$ transitions, are evaluated with experimentally determined relaxation times. Ratio

of the two required relaxation times found to have an insensitive dependence upon W_2/W_1, could be obtained only from relaxation plots extending over at least a 12- to 15-dB range. These measurements could be made only for temperatures below about 77°K. Below about 15°K, a third relaxation time was required to describe observed relaxation curves. Determination of spin-lattice relaxation times from the stimulated echo gave more accurate results than the conventional two-pulse technique. Existing theory developed for nuclei with spin 3/2, which was reformulated for nuclei with spin 5/2, was not found to be in agreement with experimental results, due to limited data describing the temperature dependence of molecular torsional oscillations. Assuming a temperature dependence for molecular vibrational frequencies, as often done in the analysis of the temperature dependent observations of the pure quadrupole resonant frequencies, better agreement can be obtained between expressions for W_2/W_1 and experimentally determined values. As a secondary effort, the free induction decay and the spin-phase memory time were measured as a function of temperature, and the results are discussed in terms of existing theories. Author

N65-24952# Oak Ridge National Lab., Tenn. Solid State Div.
CROSS SECTIONS FOR ATOMIC DISPLACEMENTS IN SOLIDS BY FAST ELECTRONS
O. S. Oen May 1965 56 p refs
(Contract W-7405-ENG-26)
(ORNL-3813) CFSTI: $3.00

The Mott series was used to calculate the number of displacements produced by elastic collisions between fast electrons and atomic nuclei. Displacement cross sections of 18 different elements spanning the atomic table were calculated for electron energies ranging from threshold to 10 MeV. Both the primary and the cascade using the Kinchin and Pease model were calculated using sharp displacement thresholds ranging from 15 to 50 eV in steps of either 5 or 10 eV. The results are compared with those using the less accurate McKinley–Feshbach formula commonly used in radiation damage studies. In addition, tables giving the differential cross section in steps of 7 1/2° for both the Mott series and the McKinley–Feshbach formula are included. Author

N65-24966# Atomic Weapons Research Establishment, Aldermaston (England).
NEUTRON CROSS SECTIONS OF Pu-239 IN THE ENERGY RANGE 1 keV TO 15 MeV
A. C. Douglas and J. F. Barry Jan. 1965 114 p refs
(AWRE-O-79/64)

Recommended values are given for the neutron total and partial cross sections of Pu^{239} in the energy range 1 keV to 15 MeV. The available experimental evidence is surveyed and is supplemented by estimates based on nuclear theory. Details of energy and angular distributions are given so that the data are complete for the purposes of neutronics calculations. The values given in this report have been combined with the data of Schmidt [3] below 1 keV and have been written on punched cards (3/Pu^{239} data, Nuclide Identification Number NIN = 184) as part of the UKAEA Nuclear Data Library. Author

N65-25005*# Pittsburgh Univ., Pa. Dept. of Physics
LOW-ENERGY ELECTRON-ATOM AND ELECTRON-MOLECULE SCATTERING THEORY CIRCA 1964
E. Gerjuoy 10 May 1965 23 p refs
(Grant NsG-416)
(NASA-CR-62896; SRCC-3) CFSTI: HC $1.00/MF $0.50

Recent theoretical work on electron scattering from atoms and molecules in low-energy ranges is discussed generally. Interest in calculating electron scattering cross sections is concentrated in the nonrelativistic area, since most applications, such as study of laboratory discharges, the ionosphere, stellar atmospheres, and nuclear blast phenomena, involve energies less than a few hundred electron volts. The Born method of calculating first-order approximations to electron scattering profiles, which are poor at the low-energy levels, are discussed. Higher-order approximations derived from use of the Born series and by an adiabatic method are reviewed, which are regarded as generally unsatisfactory methods. J.M.D.

N65-25128 Lockheed Missiles and Space Co., Palo Alto, Calif. Electronic Sciences Lab.
IONIZATION COEFFICIENTS IN HYDROGEN
L. H. Fisher, D. E. Golden, and H. Nakano *In its* Progr. Rept., Jan.–Mar. 1965 [1965] 8 p (See N65-25125 14-34)

The breakdown ionization current I in a uniform electric field E with gas at pressure p_t may be written as

$$I/I_0 = \exp[\eta(V - V^*)]/[1 - \gamma(\exp[\eta(V - V^*)] - 1]$$

where η is the average number of electrons created in the gas by an electron per unit of potential difference applied across the gap; γ is the average number of secondary electrons liberated from the cathode which escape the cathode per positive ion produced in the gas; I_0 is the electron current liberated from the cathode by external means which escapes the cathode; V is the gap voltage; and V^* is the voltage through which the electrons must move in order that the electrons have a velocity distribution characteristic of the applied value of E/P_t. New measurements of η in H_2 were made for $50 \leq E/p_0 \leq 800$. The data were obtained at constant values of E/p_0 and density by varying p_0. The data were then analyzed by an iterative procedure using a variation of parameters with the aid of a computer. The validity of Townsend's ionization function in nonuniform electric fields in H_2 is also discussed. E.E.B.

N65-25177# United Kingdom Atomic Energy Authority, Harwell (England). Health Physics and Medical Div.
THEORETICAL STUDY OF THE RUBBINO PROTON RECOIL SPECTROMETER FOR MEASURING NEUTRON ENERGY SPECTRA
J. R. Keane Nov. 1964 29 p refs
(AERE-R-4686) HMSO: 4s

The efficiency and energy resolution of a Rubbino proton recoil spectrometer, for measuring neutron energy spectra from standard sources and accelerator targets, were calculated for various values of the design parameters. The calculated efficiency is in agreement with a reported experimental value. There is disagreement between the calculated resolution at low energies and the resolution reported elsewhere. The useful lower energy limit is shown to be about 2 MeV. At higher energies a device of good resolution (5%) is practicable by careful choice of parameters but the efficiency is low (0.4×10^{-6}% at 4.5 MeV, including source-counter geometry). Advantages of the spectrometer are simplicity of interpretation of spectra and lack of response to gamma-ray background. Author

N65-25234# Rochester Univ., N. Y. Dept. of Physics
POSSIBLE EFFECTS OF CP VIOLATION IN $K^{\pm} \rightarrow 3\pi$ DECAY
Yoshiaki Ueda and Susumu Okubo 15 Apr. 1965 36 p refs
(Contract AT(30-1)-875)
(UR-875-82)

The effects of CP violation in K—3π decay were investigated. In a linear energy approximation for the decay matrix elements, it can be proved using the TCP theorem alone that the partial decay rate of the τ (or τ') mode (also θ modes) for the K^+ meson is nearly equal to that for the K^- meson, provided that contributions can be neglected from the final I = 3 pion configuration. Also, effects of final pion–pion interactions were computed by extending the dispersion-theoretical treatment of Khuri–Treiman. Author

N65-25235# Rochester Univ., N. Y. Dept. of Physics and Astronomy

HIGHER SYMMETRY GROUPS WITH PARITY MIXING

R. E. Marshak, S. Okubo, J. Schechter, and J. Wojtaszek 27 Apr. 1965 33 p refs Submitted for Publication

(Contract AT(30-1)-875)

(UR-875-83)

The groups USp(6), R(6), and U(6), which follow from chiral decomposition of a triplet of Dirac fields interacting via the tensor, scalar or pseudoscalar, and axial vector four-fermion interactions, respectively, were studied. It was found that USp(6) commutes with the parity operation whereas R(6) and U(6) do not, which means that SU(3) multiplets of opposite parity appear in the same irreducible representation of the R(6) or the U(6) group but not of the USp(6) group. Furthermore, in the two cases of parity mixing within the same irreducible representation, SU(3) multiplets of zero triality are always accompanied by SU(3) multiplets of opposite parity and non-zero triality. It was also found that invariance under R conjugation must hold for the USp(6) and U(6) groups but not for the R(6) group. The R(6) may eventually be chosen as the most interesting example of a group which commutes with the full Lorentz group except for the discrete parity operation. J.M.D.

N65-25236# Rochester Univ., N. Y. Dept. of Physics and Astronomy

ON THE COUPLING AND RECOUPLING OF RELATIVISTIC STATES

Haim Goldberg 29 Apr. 1965 32 p refs Submitted for Publication

(Contract AT(30-1)-875)

(UR-875-84)

Systems containing more than two relativistic particles are analyzed from the point of view of IRs of the Poincare group. Corresponding Clebsch–Gordan coefficients are calculated for three-particles systems, as well as recoupling functions which are the analog of the Racah coefficients. Applications are made to one-particle-production and scattering amplitudes and a kinematic proof of crossing symmetry is given. Differential cross sections are calculated in terms of amplitudes appropriate to the scheme defined. Author

N65-25268*# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Geo-Astrophysics Section

CALCULATION OF HYDROGEN ATOM CROSS SECTIONS Final Report, 15 May 1964–15 May 1965

Frank R. Pomilla and S. N. Milford May 1965 82 p refs

(Contract NASw-894)

(NASA-CR-83147; RE-210) CFSTI: HC $3.00/MF $0.75

Born cross sections for double inelastic collisions between two hydrogen atoms are calculated. Cases in which one atom is initially in the ground state, and in which both atoms are initially in excited states, are studied for center of mass energies from 2 keV to 100 MeV. The hydrogen atom–hydrogen atom Born differential cross section is formulated in terms of the electron–hydrogen atom Born differential cross sections for each colliding atom. The hydrogen atom–hydrogen atom total cross sections are calculated by numerical integration of the differential cross sections. Total level cross sections (for $n \rightarrow n'$) are calculated from the cross sections for the transitions ($nl \rightarrow n'l'$) between the different electronic orbitals by taking the appropriate averages over l and summations over l'. Results show the following: (1) For a given transition on one atom, the cross sections for the optically allowed dipole sections for the optically allowed dipole transitions $\Delta l = 1$ on the other atom do not predominate over those for the optically forbidden transitions $\Delta l > 1$. (2) At all energies, the excited atom–excited energies, the total level cross sections ($1 - 2$; $n \rightarrow n + 1$) are apprroximately independent of n for $n \geq 2$. (4) At high enough incident energies (E), the Boorn total cross sections are proportional to E^{-1} for the various double inelastic collisions studied. energies (E), the Born total cross sections are proportional to E^{-1} for the various double inelastic collisions studied. Author

N65-25291# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.

THE CALCULATION OF GAMMA-RAY SHAPES FOR SODIUM IODIDE SCINTILLATION SPECTROMETERS. COMPUTER PROGRAMS AND EXPERIMENTAL PROBLEMS

R. L. Heath, R. G. Helmer, L. A. Schmittroth, and G. A. Cazier Apr. 1965 168 p refs

(Contract AT(10-1)-205)

(IDO-17017) CFSTI: $5.00

A method is described for the calculation of pulse-height distributions which represent the response of a NaI scintillation spectrometer to monoenergetic photons. The method is based upon an interpolation between experimental spectra for sources emitting only one gamma ray. A detailed description of the experimental procedures used to accumulate input data is given. This discussion includes the analysis of photopeak shapes, detector efficiency, nonlinear relationship between energy and pulse-height for NaI, and a general consideration of problems incidental to the analysis of gamma-ray spectra. The interpolation method is described, and the computer program devised to carry out this procedure is outlined in detail. The resulting calculated gamma-ray shapes are compared with the input shapes and other simple spectra. Examples of the use of calculated gamma-ray shapes for the analysis of complex spectra are presented. The complete program listings are included, together with flow charts. Listings of sample input to and output from the programs are given. In addition, computer programs are briefly described which are designed to gain-shift spectra, to fit modified-Gaussian functions to photopeaks, to calculate coincidence sum spectra, and to do least-squares fits to complex spectra with calculated gamma-ray shapes and other components. Author

N65-25296# Oak Ridge National Lab., Tenn.

ELECTRONUCLEAR DIVISION ANNUAL PROGRESS REPORT, PERIOD ENDING DECEMBER 31, 1964

Robert S. Livingston and Alexander Zucker Jun. 1965 116 p refs

(Contract W-7405-ENG-26)

(ORNL-3800) CFSTI: $4.00

With the installation of the external beam system in the Oak Ridge Isochronous Cyclotron (ORIC) completed, extracted beams of 34- to 60-MeV protons, 50- to 80-MeV alpha particles, and 25- to 40-MeV deuterons and molecular hydrogen

have become available. Over a dozen experiments are described, along with their results and interpretation, in a variety of fields. Most of the work concerns direct reactions in medium-weight elements, but effort was also devoted to elastic scattering polarization experiments. Various aspects of transfer reactions, the statistical model, and nuclear decay schemes were investigated. Theoretical physics investigations continued to center on nuclear structure theory, especially the shell model, and on the study of nuclear reaction mechanisms. The techniques used in improving ORIC performance are described along with the new components developed for the cyclotron and for the associated research equipment. In the studies of the advanced accelerator designs, the principal activity centered on a broad study of the Separated Orbit Cyclotron (SOC) for application in the energy region under 1 BeV. Preliminary studies confirm that the SOC concept is sound, and the cost of such a machine is reasonable; furthermore, the SOC has substantial advantages over both the isochronous cyclotron and the linear accelerator. Development studies leading toward a design concept for a high-current 800-MeV SOC are described. Author

N65-25302# Uppsala Univ. (Sweden). Quantum Chemistry Group

IMPROVED SINGLE-PARTICLE PROPAGATORS IN THE THEORY OF CONJUGATED SYSTEMS

Jan Linderberg and Yngve Ohrn 15 Jul. 1964 26 p refs *Its* Preprint No. 128

(Contract AF 61(052)-701)

Pi-electron theory is studied from a field-theoretic point of view and an extension of the Hückel theory is derived, which takes into account intra-atomic correlations. Explicit solutions are given for particle and hole states in even alternant hydrocarbons. Quasi-particle energies and interactions determine the excitation spectrum, and calculations on benzene exhibit fair agreement with observed transition energies and suggest a reconsideration of the current symmetry assignments. Author

N65-25303# Uppsala Univ. (Sweden). Quantum Chemistry Group

LOWER BOUNDS FOR THE EIGENVALUES OF FIRST ORDER DENSITY MATRICES

Werner Kutzelnigg and Vedene H. Smith 15 Sep. 1964 17 p refs *Its* Preprint No. 132

(Contract AF 61(052)-701)

Lower bounds for the first n eigenvalues of the first-order density matrix corresponding to a quantum mechanical state of an n-electron system are derived under these assumptions: (1) that one knows a lower bound to the overlap integral of an arbitrary normalized Slater determinant with the true wave function; (2) that the configuration interaction expansion of the true wave function contains only singly, doubly, etc., up to m-fold excited configurations with respect to a ground configuration, where $m \leq n$; (3) that the electronic interaction term in the Hamiltonian is proportional to a parameter λ and that a perturbation expansion in terms of this parameter is possible. In the latter case one finds that the idempotency of the one particle density matrix is stable with respect to first-order perturbations. Author

N65-25331# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

INDEX—A COMPUTER PROGRAM FOR INDEXING X-RAY DIFFRACTION POWDER PATTERNS

J. B. Goebel and A. S. Wilson Jan. 1965 60 p refs

(Contract AT(45-1)-1830)

(BNWL-22) CFSTI: $3.00

Input data for this program are the 2θ reflections where θ is the Bragg angle measured by a diffractometer from powdered crystalline samples. Additional data that may be supplied are X-ray wavelengths, a possible error value, empirical gram formula weight and observed density. The program indexes the set of reflections on the basis of cubic, hexagonal, tetragonal, and orthorhombic systems in that order. All lattice constants are calculated by an iterative least-squares procedure. Printed output includes the crystal system, the lattice constants and their standard deviations, the wavelengths used, observed and calculated $\sin^2\theta$ values, and the difference between the latter two. An error term, E, is also printed as well as the number of formula units per unit cell in some cases. The value of E, the size of the lattice constants and their standard deviations, indicate the validity of the indexing. The Miller indices are printed in the form $h^2+k^2+l^2$ in the cubic, h^2+hk+k^2 and l^2 in the hexagonal, h^2+k^2 and l^2 in the tetragonal, and h^2, k^2, and l^2 in the orthorhombic case. A typical indexing problem requires about 3 min on a 7090 IBM computer. Author

N65-25375# Rochester Univ., N. Y. Dept. of Physics and Astronomy

SPARK CHAMBER TESTS OF MULTIPLE PARTICLE DETECTION EFFICIENCY

James W. Ryan 10 Dec. 1964 10 p refs Submitted for Publication

(Contract AT(30-1)-875)

(UR-875-66)

Tests made on a spark chamber using 0.015-inch nylon sheets between conducting electrodes show that the efficiency per gap for particle detection is close to 100% when up to 12 monoenergetic particles traverse the chamber within its sensitive time. Large variations existed in the number of residual electrons when the high voltage was applied, and it was concluded that a dependence between intensity and specific ionization exists. It is suggested that the time width of the high voltage pulse be made as short as is consistent with the spark formation time so that no additional visible spark channels have time to develop in the chamber due to electrons produced by photoionization. The significance of the rapid decrease in efficiency with the relative number of residual electrons is indicated by the nearly zero efficiency of detecting a particle whose track has one-half the maximum number of residual electrons. It was concluded that under suitable conditions the spark development time may not be so weakly dependent upon the number of ionization electrons as previously indicated. G.G.

N65-25432# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

NUSTAT: AN APEX PROGRAM FOR FULLY MECHANIZED SHELL MODEL CALCULATIONS

T. D. Newton Mar. 1965 42 p refs

(AECL-2223; CRT-1218) Available from Atomic Energy of Canada, Ltd., Chalk River: $1.00

This report contains an outline of a program for mechanical determination of bound states in a shell model of nucleus. Limitations on magnitudes of soluble problems are stated. The program has been written for the G-20 computer in APEX language. Author

N65-25433# Rochester Univ., N. Y. Dept. of Physics and Astronomy

LIMITS ON PARITY AND TIME REVERSAL NONINVARIANCE IN p–p SCATTERING

E. H. Thorndike 15 Dec. 1964 52 p refs Submitted for Publication
(Contract AT-(30-1)-875)
(UR-875-67)

The formalism for p-p elastic scattering developed includes the possibility of parity nonconservation and time reversal noninvariance. Relevant experimentally measurable quantities are defined. An experiment measuring three quantities is described, and these and other measurements relevant to parity nonconservation or time reversal noninvariance are analyzed in terms of the formalism developed. No evidence is found for any violation of either invariance principle. The parity conserving, time reversal noninvariant coupling of $^3P_2$ and $^3F_2$ states is at most 7% of its maximum possible value, in the energy range 140 to 210 MeV. The parity nonconserving, time reversal invariant coupling of $^1S_0$ and $^3P_0$ states is at most 70% of its maximum possible value, at 140 MeV. The parity nonconserving, time reversal noninvariant coupling of $^1S_0$ and $^3P_0$ states is not bounded from its maximum possible positive value, and is at most 60% of its extreme negative value, at 140 MeV. The evidence against parity nonconservation is thus weak. Author

N65-25436# United Kingdom Atomic Energy Authority, Harwell (England). Nuclear Physics Div.
THE CYCLIC CONTROL UNIT
G. Peckham Jul. 1964 10 p ref
(AERE-M-1424)

In neutron scattering experiments, it is frequently desirable to arrange for several samples to be placed in the beam one after the other for short periods, the cycle being repeated many times during an experiment. The cyclic control unit is designed to control the sample changing mechanism and to switch the recording apparatus as necessary. Author

N65-25452# Industrial Science and Technology Agency, Tokyo (Japan). Electrotechnical Lab.
STUDY OF CRITICAL EQUATION OF REACTOR
Tetsu Nagayama Nov. 1964 61 p refs In JAPANESE; ENGLISH summary
(Rept.-653)

A second-order differential equation is developed to describe the asymptotic space-dependent thermal neutron spectrum in a finite multiregion medium by using Wilkins method in the thermal energy region and the fast neutron spectrum is assumed to be of 1/E distribution. Critical calculation was carried out on one-dimensional bare and multiregion D_2O reactor according to this theory. These results are compared with results obtained by other methods that use the effective cross section, and the validity of this theory was demonstrated. Author

N65-25461# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
STUDY AND EXPERIMENTAL WORK ON ATOMIC COLLISION PROCESSES OCCURRING IN ATMOSPHERIC GASES
Technical Progress Letter No. 40, 1 Jul.–30 Sep. 1964
A. V. Phelps 30 Sep. 1964 8 p
(Contract AF 29(601)-6271)
(RM-64-9E2-113-M2; AD-461046)

Microwave discharges in O_2–Ne mixtures studied have led to the assumption that O_2 ions are formed via the Penning reaction with neon metastable atoms. The energetics of this reaction permit the formation of O_2 ions in both the ground state and in a long lived metastable state. Atomic oxygen was also produced by nitric oxide titration of the active nitrogen produced in a nitrogen discharge. Further, the electron attachment rate in O_2–H_2O mixtures at 300° K was measured. The thermal three-body attachment coefficient in oxygen at 300° K obtained was in agreement, within experimental error, with the value of 2.2×10^{-30} cm^6/sec previously obtained from O_2–CO_2 mixtures. E.E.B.

N65-25474# Stanford Univ., Calif. Stanford Linear Accelerator Center
EFFECT OF NUCLEAR RADIATION ON ORGANIC MATERIALS; SPECIFICALLY MAGNET INSULATIONS IN HIGH-ENERGY ACCELERATORS
H. Brechna Mar. 1965 95 p refs
(Contract AT(04-3)-515)
(SLAC-40) CFSTI: $3.00

Tests carried out at the Center, in which several commercially available insulations were found to deteriorate severely at total doses of as low as 10^{10} rads, are described. Changes in molecular structure induced by radiation effects and degradation of electrical and mechanical properties are discussed. The development and testing of an insulation using pure Al_2O_3 fillers which has retained approximately 25% of its original mechanical strength at an absorbed radiation dose of 3.25×10^{12} rads are described. This insulation requires minor changes in the usual winding and "potting" techniques prevalent in the industry. Certain changes in the crystal structure of the filler are observed under irradiation. Author

N65-25488# United Kingdom Atomic Energy Authority, Windscale (England). Reactor Development Lab.
A PROJECTION METHOD FOR MEASURING ELECTRON DIFFRACTION PATTERNS OF SINGLE CRYSTALS AND POLYCRYSTALS
R. Sumerling 1965 11 p refs
(TRG-949(W))

An improved projection method for measuring selected area electron diffraction patterns is described which is rapid and accurate to within ±0.5%. Corrections are automatically made for radial variations in camera factor and for any elliptical distortion, so that the method is as readily applicable to single crystals as to ring patterns. Author

N65-25494# United Kingdom Atomic Energy Authority, Harwell (England). Health Physics and Medical Div.
AN APPLICATION OF THE LOG-NORMAL DISTRIBUTION TO SOME AIR SAMPLING RESULTS AND RECOMMENDATIONS ON THE INTERPRETATION OF AIR SAMPLING DATA
R. F. Hounam Mar. 1965 23 p refs
(AERE-M-1469, Rev.) HMSO: 3s 6d

Three recent series of air sampling results separately analyzed are shown to conform approximately to a log-normal distribution. This finding is followed by a suggestion of how the log-normal distribution may be applied to a series of conforming air sampling results to estimate the hazard to individuals exposed to the same environment. Author

N65-25513# Joint Publications Research Service, Washington, D. C.
CONVERGENCE IN THE SPLITTING METHOD FOR THE RADIATION TRANSFER EQUATION

G. I. Marchuk 8 Jun. 1965 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Mat., Fiz., (Moscow), no. 1-3, 1965 p 66-69
(JPRS-30499; TT-65-31210) CFSTI: $1.00

Application of the solution for the multivariate kinetic equation of radiation transfer to the transfer equation for a case of plane parallel geometry on the assumption of isotropic scattering is discussed. The transfer equation assumes the form

$$\mu\delta\phi/\delta z + \sigma\phi = \sigma_s/2\int_{-1}^{1}\phi\,d\mu + f(z,\mu)_2$$

if ϕ is the radiation flux and σ and σ_s are the cross sections of the interaction between radiation and matter. The solution of this equation in the rectangle is found and can be extended to the radiation transfer in spherical and cylindrical geometries. G.G.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N65-24402# Microwave Associates, Inc., Burlington, Mass.
STUDY OF PLASMA AMPLIFIERS Final Report
K. K. Chow 15 Feb. 1965 114 p refs
(Contract AF 19(628)-452)
(AFCRL-65-158; AD-614253)

Electromagnetic signals interacting with a plasma were investigated. One phase deals with fast wave interaction between microwave field and a plasma; and the other phase deals with the interaction of a plasma with fields by means of any general noncollective phenomena. Specifically, use of recombination radiation at optical frequencies is studied. Theoretical considerations for optical frequencies indicate that a low temperature plasma with high density, high degree of ionization is necessary. Thermal-contact ionization of cesium is chosen as the most suitable means. Fabrication of this plasma generator and the attendant technological problems are discussed. Experimental results show that recombination radiation was obtained in this type of plasma. However, because of the low plasma density attainable, optical oscillation could not be initiated. Schemes are suggested to increase the density and degree of ionization. Studies on gas lasers were carried out. Optical resonator modes in a Br_2-Ar laser are examined. Excellent agreement between experimental and theoretical results is obtained. Author

N65-24530 Joint Publications Research Service, Washington, D. C.
ON THE RADIATION FROM A CHARGE MOVING THROUGH A MEDIUM WITH FLUCTUATING PARAMETERS
V. V. Tamoykin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 51-60 refs (See N65-24525 14-07) CFSTI: $7.00

Analyzed is the radiation from a charge moving in a gas with thermodynamic pressure and entropy fluctuations and in a plasma with thermal fluctuations of electron density. It is shown that in certain cases the spectral radiation density of electromagnetic waves may be smaller than the radiation energy of the charge moving in a disorderly heterogeneous medium with time-independent parameters. Author

N65-24546 Joint Publications Research Service, Washington, D. C.
ON THE THEORY OF NONLINEAR INTERACTION OF LONGITUDINAL AND TRANSVERSE PLASMA WAVES
A. Gaylitis and V. N. Tsytovich *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 235-241 refs (See N65-24525 14-07) CFSTI: $7.00

Transformation of longitudinal waves into transverse waves and the effects of nonlinear interaction of longitudinal waves with longitudinal waves were examined in a number of works, but the nonlinear effects of the interaction of longitudinal waves with transverse waves were not analyzed. The present work endeavors to show that the nonlinear interaction of longitudinal waves with transverse waves may be considerable, and in a number of cases is more substantial than the interaction of longitudinal waves with one another. Nonlinear interaction of plasma waves is examined, both of the transverse and longitudinal waves having frequencies close to the plasma frequency of Langmuir oscillations in the case of an isotropic plasma. The interest in this question is explained by the circumstances that for these frequencies the nonlinear effects of pumping-over in the spectrum and of the transformation of longitudinal waves into transverse waves, and vice versa, take place chiefly on the thermal particles of the plasma. Author

N65-24548 Joint Publications Research Service, Washington, D. C.
ON THE NONLINEAR THEORY OF ELECTROMAGNETIC WAVES IN SEMICONDUCTORS AND PLASMA
F. G. Bass and S. I. Khankina *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 246-250 refs (See N65-24525 14-07) CFSTI: $7.00

A theoretical analysis of the propagation and absorption of strong electromagnetic waves in semiconductors and plasma is presented, which is based on the following assumptions: that the relationship $|\omega-\omega_h| >> \nu$; $\omega_h >> \nu$ exists between the frequency of the propagating field ω, Larmor frequency $\omega_h = |e|h/mc$ and the frequency of the collision ν; and that the conduction of the sample is affected by one type of carriers. Examined were the problem of normal wave incidence from a vacuum into a half space filled with a semiconductor, and hybrid resonance appearing when two types of current carriers are present at the frequency of $\omega^2 = e^2h^2/m_n m_p c^2$ with $\omega|\omega_{Hs} - \omega| >> \nu$, $\omega^2 o_s >> |\omega_{HS} - \omega^2|$ in the propagation of the wave perpendicular to the magnetic field. S.C.W.

N65-24555 Joint Publications Research Service, Washington, D. C.
ON NORMAL WAVES IN A ROUND WAVEGUIDE FILLED WITH PLASMA WHEN CALCULATING SPATIAL DISPERSION
V. Ya. Eydman *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 281-284 refs (See N65-24525 14-07) CFSTI: $7.00

An analysis of the problem of normal waves in a round waveguide filled with isotropic plasma in weak spatial dispersion calculations is presented. Also considered is the problem of wave emission induced by emitters, such as an oscillator oriented parallel to the waveguide axis, and a charge moving at a constant rate along the waveguide axis. S.C.W.

N65-24556 Joint Publications Research Service, Washington, D. C.
AN EXPERIMENTAL INVESTIGATION OF A SPACE CHARGE IN A CYLINDRICAL MAGNETRON UNDER STATIC CONDITIONS

L. M. Groshkov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 285–293 ref (See N65-24525 14-07) CFSTI: $7.00

An experimental investigation of the space charge in the upper portion of the electron cloud of a magnetron is reported. Using the electron optical X-raying method, experimental curves were derived for electron trajectories for the case when the space charge was absent in the magnetron, under conditions of a total space charge in the magnetron; and for single flux, two flux, and bidromic states. Results show that the potential in the upper and lower portion of the electron cloud is similar to the distribution described by the theory of bidromic state of the space charge with two-loop trajectories of the electrons. In support of these results, the existence of a virtual cathode in the center of the electron cloud of the magnetron is demonstrated. S.C.W.

N65-24605# Nagoya Univ. (Japan). Inst. of Plasma Physics
ANOMALOUS BREMSSTRAHLUNG AND ANOMALOUS CYCLOTRON EMISSION FROM PARTIALLY IONIZED GASES
Shigetoshi Tanaka, Hideo Ikegami, Tadao Honzawa, and Kazuo Takayma Nov. 1964 43 p refs
(IPPJ-32)

Anomalous emission at the electron cyclotron frequency in a partially ionized plasma was measured and studied in the radio frequency range below 1000 Mc/s. It could be observed only when the detecting frequency was above some critical frequency. The anomalous emission appeared also at the 2nd cyclotron harmonic. The critical frequency was in the range 70 to 40 Mc/s and was somewhat smaller than the collision frequency of plasma electrons. Anomalous bremsstrahlung was observed in the weaker external magnetic field when the detecting frequency was less than the critical frequency. Characteristics of both anomalous emissions were similar and capable of explanation by the same physical mechanism. The following interpretation was proposed: If the anomalous cyclotron emission results from the effect of negative absorption due to the cyclotron radiation, then the anomalous bremsstrahlung is a phenomenon of the negative absorption due to the bremsstrahlung. It is reasonable that the anomalous cyclotron emission and the anomalous bremsstrahlung occur at a high frequency region and at a low frequency region, respectively. Author

N65-24630# Sandia Corp., Albuquerque, N. Mex.
ASSEMBLY OF AN ARGON PLASMA IN MAGNETIC MIRROR GEOMETRY
John R. Banister, Everet H. Beckner, and Richard D. Jones Sep. 1964 25 p refs
(SC-RR-64-988)

The assembly of an argon plasma in a magnetic mirror geometry which was generated by twin electrodeless ring discharges was examined by using a high-speed framing camera and by extensive magnetic probing. The survey was carried out over a density range sufficient to permit observation of a wide variety of phenomena, from a totally ballistic assembly at 3 torrs of initial pressure to an assembly dominated by magnetic forces at the lowest density (0.03 torr initial pressure). It was found that the early assembly could be described by a snowplow model at the lower initial pressures (0.03 and 0.3 torr). Substantial magnetic field compression was observed at these lower initial densities with the development of magnetic tension effects. This field compression was also accompanied by the appearance of an early luminosity in the case of the lowest initial density. This luminosity indicates breakdown of the ambient gas which occurs when photoelectrons are accelerated by the azimuthal electric field. The magnetic probing revealed evidence of a tensor electrical conductivity in the plasma generated at the lowest initial pressure. Author

N65-24658*# National Aeronautics and Space Administration, Washington, D. C.
DRIFT INSTABILITY OF A NONUNIFORM PLASMA IN A MAGNETIC FIELD [DREYFOVAYA NEUSTOYCHIVOST' NEODNORODNOY PLAZMY V MAGNITNOM POLE]
B. B. Kadomtsev and A. V. Timofeyev Nov. 1962 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 146, no. 3 21 Sep. 1962 p 581–584
(NASA-TT-F-8314) CFSTI: HC $1.00/MF $0.50

Drift flows of ions and electrons in a nonuniform plasma situated in a uniform magnetic field directed along the axis were investigated, with the effect of the finite Larmor radius of ions considered. It was assumed that the distribution of electrons and ions along the transverse velocities is Maxwellian, that the oscillation frequency is much lower than the cyclotron frequency of ions, and that the oscillations with a transverse wavelength are much greater than the Larmor radius of electrons. It was concluded that a nonuniform isothermic plasma in a strong magnetic field is unsteady relative to the buildup of drift-type waves with a transverse wavelength of the order of the mean Larmor radius of ions. The corresponding perturbations are strongly stretched along the magnetic field's line of force so that the instability manifests itself only in the configurations whose longitudinal length exceeds by one order the transverse length. G.G.

N65-24735# Nihon Univ., Tokyo (Japan). Dept. of Physics
ON THE HIGHER ORDER CORRECTIONS TO THE ALFVEN WAVE INSTABILITY
Masatomo Sato [1964] 14 p refs
(NUP-65-6)

The higher order corrections to the instability of an Alfvén wave, propagating along an external magnetic field in a plasma of anisotropic pressure components, are considered on the basis of the Vlasov equations. It is shown that terms of the order of $1/\Omega_i^2$, besides those of $1/\Omega_i$, should be retained as correction terms to the lowest order (Chew–Goldberger–Low) dispersion relation to obtain a correct criterion of stability. The result is to expand slightly the region of instability, and there is no "finite Larmor radius stabilization effect" as obtained from the modified C.G.L. approximation. Author

N65-24764# Centro Nacional de Radiación Cósmica, Tucuman (Argentina).
INTRODUCTORY COURSE ON MOTION OF CHARGED PARTICLES IN STATIC MAGNETIC FIELDS
J. G. Roederer Buenos Aires, Comision Nacl. de Invest. Espaciales, 1965 47 p refs
(CNIE-PE-1)

The fundamentals of charged particle motions under the influence of magnetic fields are introduced. Included in the discussion are particle motions in static homogeneous magnetic fields; homogeneous magnetic fields subject to an external force such as electricity, gravity, or inertia; inhomogeneous magnetic fields with a gradient parallel to the field direction; the adiabatic invariants; flux relations for trapped particles in a stationary state; the scattering effect of a trapped particle flux; the geometric properties of the pure dipole field; particle trapping in a pure dipole field and a disturbed dipole field; and trapped particle motion in time dependent magnetic fields. R.N.A.

N65-24783# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

MHD TURBULENT SHEAR FLOW IN WEAKLY CONDUCTING FLUIDS

Albert L. Loeffler, Jr. Nov. 1964 22 p refs (RE-195)

The effect of a transverse magnetic field on a high Reynolds number flow of a weakly conducting incompressible fluid is studied theoretically. The flow occurs between two electrically insulated infinite parallel plates, and is assumed to be fully developed. A small perturbation technique is employed. Under the previously mentioned conditions of very large values of inertial to magnetic forces, the effects of the magnetic field on the turbulent fluctuations can be neglected compared to the effects on the mean flow. The total mean velocity is calculated and plotted against Hartmann number, and the results appear reasonable for Hartmann numbers up to about four. Hartmann number is based on the channel half-width. The increase over the ordinary turbulent value of the friction factor is shown to be proportional to M^2/Re, where M is the Hartmann number and Re the Reynolds number. Comparison is made with available experimental data. The agreement is reasonably good for values of M^2/Re up to about 4×10^{-4}. It is expected that better agreement would be obtained with higher Reynolds number data. Author

N65-24842# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

BIBLIOGRAPHY OF PLASMA PHYSICS

George P. Bein Jul. 1964 98 p refs (CAL-ER/RIS-3)

N65-24962# General Electric Co., Philadelphia, Pa. Space Sciences Lab.

RADIATION EMITTED FROM A HIGH TEMPERATURE NONEQUILIBRIUM NITROGEN PLASMA

John L. Kulander Jun. 1965 54 p refs (R65SD13)

The spectral distribution of radiation emitted from a uniform plane-parallel layer of low density nitrogen plasma is obtained for various layer thicknesses. Electron densities from 10^{13}–10^{19} e/cm^3 and electron temperatures between $10^{4°}$ and $10^{6°}$ K are assumed. The system is not in a state of local thermodynamic equilibrium because at the low densities considered the transition rates are not collision dominated nor is the gas optically thick. Electrons contributed from sources other than nitrogen are possible, although no sources of radiation other than nitrogen are assumed. The plasma is irradiated by an external diluted Planckian field W $B_\nu(T_r)$. The occupation numbers of the various energy levels are obtained through simultaneous solution of the population rate equations and the Eddington transfer equation. Author

N65-25129 Lockheed Missiles and Space Co., Palo Alto, Calif. Electronic Sciences Lab.

PROPAGATION OF ELECTROMAGNETIC WAVES THROUGH PLASMAS

R. M. Hill, G. F. Herrmann, S. J. Tetenbaum, and R. F. Whitmer *In its* Progr. Rept., Jan.–Mar. 1965 [1965] 15 p refs (See N65-25125 14-34)

The resonant behavior of an rf-excited, electrodeless magnetoplasma in the vicinity of the harmonics of the electron cyclotron frequency was investigated. The experiment consisted of recording the intensity of the 9.15-Gc radiation emitted from one side of the discharge and propagation of the extraordinary wave mode (ETB) as the applied magnetic field was swept. The field was uniform within 0.5% over the effective volume of the discharge. When the receiving horn was rotated 90° to receive the ordinary wave ($\vec{E} \| \vec{B}$), the radiation intensity was reduced about 5 dB. The detector was a superheterodyne receiver with a noise figure of about 10 dB. Its i.f. was 30 Mc with a 2-Mc bandwidth. The local oscillator was tuned to 9.18 Gc and an image rejection filter was used to remove the radiation of 9.21 Gc. The cyclotron harmonic resonances previously found in dc-discharges were also present in the rf-excited, electrodeless discharge. The study of plasma parameters which affect line shape, intensity, and position of electron cyclotron resonance absorption and the theoretical investigation of the characteristics of a wave propagating in an ionized gas whose collision frequency is velocity dependent are also discussed. E.E.B.

N65-25130 Lockheed Missiles and Space Co., Palo Alto, Calif. Electronic Sciences Lab.

PRODUCTION AND STUDY OF A CESIUM PLASMA IN THERMODYNAMIC EQUILIBRIUM

L. H. Fisher, D. E. Golden, and R. Johansson *In its* Progr. Rept., Jan.–Mar. 1965 [1965] 10 p refs (See N65-25125 14-34)

Experimental apparatus consisting of the oven and detectors for charged particles and a plasma eater is described. The experimental work was concerned primarily with measurements of the electron flow from the oven. It was found that if the acceleration potential was applied so as to heat the oven, the outflow of electrons from the front of the oven was about 10^5 times larger than if this potential was reversed so that the heating element was more than 20 V positive with respect to the oven. Thus, it was necessary to stop the heating of the oven during the measurements of the electron outflow. Also, the conditions inside the oven, i.e., the potential of the plasma relative to the oven wall, the degree of ionization, the Debye length, and the outflow of particles through the orifice, were calculated for temperatures between 1000° and 3000° K and for cesium particle densities between 10^7 to 10^{23} particles/cc. These calculations included the effect of adsorption of cesium on the oven wall. The results thus far showed that is was possible to obtain an electron beam from the oven. E.E.B.

N65-25160# United Kingdom Atomic Energy Authority, Culham (England). Culham Lab.

METHODS FOR THE SYSTEMATIC STUDY OF MAGNETIC WELLS

J. Andreolatti 1964 6 p refs Transl. into ENGLISH from Comp. Rend. (Paris), v. 257, Aug. 1963 p 1235–1237 (CLM-TRANS-1) HMSO: 1s 2d

Investigation of the stability of a low pressure plasma in a strong magnetic field draws attention to the importance of "Magnetic Wells," i.e., fields such that a finite volume exists within which the energy density $B^2/2\mu_0$ has a minimum. Two methods are developed permitting systematic investigation of these fields. Author

N65-25162# United Kingdom Atomic Energy Authority, Culham (England). Culham Lab.

THE PRODUCTION OF HOT THERMONUCLEAR PLASMA BY THE INJECTION OF FAST PARTICLES INTO A MAGNETIC TRAP

I. N. Golovin, V. I. Pistunovich et al 1965 106 p refs Transl. into ENGLISH of I. V. Kurchatov Inst. of Atomic Energy Rept. IAE-676 (Moscow), 1964 p 1–166 (CLM-TRANS-6) HMSO: 14s

The possibility is considered of forming a dense hot plasma in a magnetic mirror trap by the injection of fast molecular ions and neutral atoms. The results are described of experiments carried out to study the accumulation of plasma by the dissociation of molecular ions on the residual gas and by a lithium arc. During dissociation on the residual gas a hot plasma is obtained with a density of 10^8 ions/cm^3, and no ion losses from the trap are observed other than by charge exchange, i.e., no losses which might prevent the attainment of a higher plasma density by the injection into the trap of a large current of molecular ions. Author

N65-25166# United Kingdom Atomic Energy Authority, Harwell (England).
ON THE PENNING DISCHARGE WITH HOT CATHODES AND ITS APPLICATION AS AN ION SOURCE
S. von Göler and H. Wagner Sep. 1964 16 p refs Transl. into ENGLISH from Proc. of the 6th Intern. Conf. on Ionisation Phenomena in Gases, SERMA, Paris, v.2, 1963 p 405–410
(AERE-TRANS-1016) HMSO: 2s 6d

The discharge characteristics of an ion source with oscillating electrons were measured. A simple theory, resulting from the particle conservation equations, is compared with the experimental data. It takes account of the essential features as the dependence on pressure, cathode heating, and magnetic field. A formula is derived which gives the correlation between the arc data and the extracted ion beam in satisfactory agreement with the experiments. Author

N65-25195# Aerospace Corp., San Bernardino, Calif.
ON THE THEORY OF CHARACTERISTICS FOR THREE-DIMENSIONAL UNSTEADY FLOWS WITH APPLICATION TO MAGNETOHYDRODYNAMICS
J. T. Yen Mar. 1965 22 p refs
(Contract AF 04(695)-469)
(BSD-TR-65-247; TDR-469(S5855-80)-2; AD-463160)

A simplified approach to the theory of characteristics for three-dimensional unsteady flows is presented, and the basic concepts of nonstanding wave elements and standing waves are reviewed. By introducing comoving coordinates, it is possible to carry out the analysis in a straightforward way, following basic concepts, yet avoiding ballooning the equations involved. Applications to magnetohydrodynamics are made. Because of the simplicity of the approach, it is possible to obtain the compatibility relations for magnetohydrodynamic characteristics in a concise form. By applying the basic concepts, it is also shown that the upstream and downstream magnetohydrodynamic waves can be constructed by joining the self-perpetuating wave elements. It is emphasized here that, for the slow magnetohydrodynamic characteristics, there are nonstanding wave elements lying outside or ahead of the standing waves. Author

N65-25265*# Maryland Univ., College Park. Inst. of Fluid Dynamics and Applied Mathematics
COLLISIONS AND NONLINEAR EFFECTS IN PLASMAS
Adrian Anatol Dolinsky (Ph.D. Thesis) 7 May 1965 154 p
(Grant NsG-220)
(NASA-CR-63162) CFSTI: HC $5.00/MF $1.50

Nonlinear and collision effects in the behavior of plasmas are investigated for an electron gas embedded in a neutralizing, uniformly smeared out background of positive charge. Nonlinearity enters into the description of the behavior of a plasma through the collision term (arising from interparticle correlations) and the self-consistent electric field term (i.e. the ensemble average of the sum of Coulomb fields of all of the plasma particles) in an exact kinetic equation. It is impossible (at the present time) to treat both nonlinear terms simultaneously. For this reason the investigation is divided into two separate parts: In Part one the effect of the collision term on the behavior of a spatially homogeneous plasma is investigated; in Part two the self-consistent electric field term is treated under conditions which enable us to drop the collision term. Author

N65-25290# New York Univ., N. Y. Courant Inst. of Mathematical Sciences
STABILITY CRITERIA AND THE INITIAL VALUE PROBLEM FOR COLLISIONLESS, GUIDING CENTER PLASMA
Abraham Kadish 1 Apr. 1965 71 p refs
(Contract AT(30-1)-1480)
(NYO-1480-22; MF-45)

Employing the system of integro-differential equations which govern a plasma in the guiding center limit, stability criteria are found for infinite, homogeneous, collisionless, guiding center plasma. A one-dimensional fundamental solution is derived for the linearized system, and a well-posedness theorem is proved for the corresponding initial value problem. Author

N65-25315# Princeton Univ., N. J. Plasma Physics Lab.
INTERPRETATION OF ATOMIC HYDROGEN LIGHT IN THE C STELLARATOR
E. Hinnov, A. S. Bishop, and F. W. Hofmann May 1964 60 p refs
(Contract AT(30-1)-1238)
(MATT-270)

Dissociation processes of H_2 sufficiently rapid to be of importance in C Stellarator discharges result in neutral atoms with kinetic energy $\gtrsim$ 0.5 eV. At these energies, the mean free path of the atoms with respect to ionization and excitation is considerably larger than the radius of the discharge, under typical conditions. Therefore, the observed atomic light must be produced by atoms returning into the discharge from the walls of the vacuum vessel (probably with kinetic energy corresponding to wall temperature). Time delay between production and ionization of atomic hydrogen appears influenced by resonant charge exchange between the inflowing slow atoms and the plasma protons. These conclusions are at least in qualitative agreement with observed time behavior, and measured radial distribution of atomic and molecular hydrogen light. From quantitative measurements of atomic hydrogen light, it appears that a substantial fraction—perhaps all—of atoms produced in the discharge return as atoms. It is also deduced from these measurements that the entire power input can be satisfactorily accounted for in terms of the hydrogen ionization, radiation, heating, and charge exchange processes. Author

N65-25338# Princeton Univ., N. J. Plasma Physics Lab.
THE BEHAVIOR OF LANGMUIR PROBES IN TIME-VARYING SITUATIONS
Francis F. Chen Jun. 1964 81 p refs
(Contract AT(30-1)-1238)
(MATT-269)

The present work analyzes, summarizes, and in some cases extends what is presently known about the behavior of electrostatic probes and sheaths in time-dependent situations. The validity of probe temperature measurements in noisy plasmas; a new technique for density measurements in plasmas too small for ordinary microwave interferometry; and the

ultimate speed with which probe measurements can be made are discussed. The technique of correlation measurements of turbulence in plasmas is introduced. Author

N65-25502# United Kingdom Atomic Energy Authority, Culham (England). Culham Lab.
DETECTION OF AN ELECTRON BEAM IN A TOROIDAL PLASMA
D. W. Atkinson and J. M. S. Schofield 1965 22 p refs
(CLM-R-39) HMSO: 3s

Two methods are described for measuring the energy and flux of an electron beam which is immersed in a high density plasma in a toroidal magnetic field when the beam energy is only a few kilovolts. The first method uses an X-ray technique which enables the mean energy of the beam to be measured directly provided the spread is small. The spectrum of X-rays emitted from a tungsten target in the path of the beam is analyzed with two or more scintillation counters and the energy and flux calculated from previous calibrations. A sufficiently monoenergetic beam, whose energy is varied over the required range, is used to calibrate the system. Total energy is measured because the determination does not depend strongly on the angle of the beam velocity to the magnetic field only. The electrons are retarded by the potential of a planar grid. Those electrons with sufficient energy to be transmitted are collected and measured. The grid potential is pulsed on for 2 microseconds, which gives insufficient time for it to break down, even when operating in plasma of density 10^{14} ions/cc, yet enough to cover the microsecond duration of the beam. Author

N65-25503# United Kingdom Atomic Energy Authority, Culham (England). Culham Lab.
STABILITY OF A PLASMA WITH FINITE β
J. Andreoletti Jan. 1965 8 p refs Transl. into ENGLISH from C. R. Acad. Sci. (Paris), vol. 258, May 1964 p 5183-5186
(CLM-TRANS-4) HMSO: 1s 2d

A necessary stability condition is obtained for an arbitrary system without magnetic surface; also obtained is a sufficient condition for a system with isotropic pressure and without parallel current. These two conditions tend toward the necessary and sufficient condition for very small and very large β, respectively. From this, the critical β is evaluated in a magnetic well, showing the importance of the transverse depth. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N65-24395# Lexington Labs., Inc., Cambridge, Mass.
INVESTIGATION OF A HIGH TEMPERATURE ELECTRICAL CONDUCTIVITY DEVICE FOR USE WITH THERMAL IMAGE HEATING Final Report, Dec. 1963-Nov. 1964
Philip S. Schaffer, Henry A. Hobbs, Jr., and Robert C. Folweiler 15 Dec. 1964 62 p refs
(Contract AF 19(628)-1616)
(AFCRL-64-1012; AD-610496)

The "double-clamshell" imaging system was successfully used to measure electrical conductivity of single crystal and polycrystalline aluminum oxide and pyrolytic boron nitride in the absence of impressed electric and magnetic fields. A furnace with a controlled atmosphere was designed and constructed for the conductivity measurements up to a temperature greater than 2130° K. Two 5000-watt xenon arc lamps were used for energy sources. At 1500° K a temperature gradient of 6° K along the empty furnace axis was measured with alumina-shielded thermocouples. The thermal conductivity of a sample reduced the gradient to less than 1° K. Author

N65-24397# Hebrew Univ., Jerusalem (Israel). Dept. of Physics
INVESTIGATIONS ON THE OPTICAL SPECTRA OF TRANSITION ELEMENTS IN SINGLE CRYSTALS OF HIGH SYMMETRY Final Technical Report
W. Low Jul. 1964 57 p refs
(Contract AF 61(052)-549)
(AFCRL-65-12; AD-610504)

The theoretical and experimental aspects of the optical spectra of the S-state ions Mn^{2+} and Fe^{3+} in cubic fields were investigated. The optical spectrum and the ground state splitting of V^{3+} in Al_2O_3 was studied. The spectrum of Pr^{3+} in the single crystal of $CaWO_4$ was measured in absorption and fluorescence. The line shape of the Pr^{3+} lines was investigated as a function of the temperature. Author

N65-24398# Innsbruck Univ. (Austria).
REPRODUCIBILITY OF MEASUREMENTS OF ELECTRIC ROCK PARAMETERS ON SPECIMENS Scientific Report No. 12
O. Wörz and Wolfram Bitterlich 1 Nov. 1964 12 p refs
(Contract AF 61(052)-490)
(AFCRL-65-32)

At frequencies from 100 cps to 100 kcps, ϵ and δ of four similar rock specimens are determined at different values of humidity. The frequency dependence of δ and ϵ at different values of humidity and the possibility of reproducing the original state after a change in humidity are discussed. Unique statements can be made on the frequency dependence, but problems arise for an exact measurement of the humidity dependence. Author

N65-24401# Stanford Univ., Calif. Microwave Lab.
SATURATION PHENOMENA IN Zn_2Y FERRITE AT FREQUENCIES BELOW RESONANCE Scientific Report No. 4
R. E. Tokheim Feb. 1965 178 p refs
(Contract AF 19(628)-342)
(ML-1290; AFCRL-65-138; AD-614235)

Saturation effects in single crystal Zn_2Y, with the easy plane lying in the plane of the disk, were measured at 1.32 kMc. The dc and rf magnetic fields were applied orthogonally in the plane of the disk. Order of the first resonant spin wave instability permitted was varied from first to fifth by adjusting the position of the spin wave manifold relative to the pump frequency. Nature of the saturation was investigated by observing the waveform of the reflected pump pulse. Theoretical on-resonance spin wave thresholds up to fourth, and off-resonance thresholds up to second order were derived. First order theoretical spin wave threshold was the lowest threshold in low dc magnetic fields. At higher dc fields second order theoretical on- and off-resonance spin wave thresholds dominated higher order thresholds. Taking the magnetoelastic effect as the dominant mechanism, first order phonon thresholds were derived for transverse and longitudinal elastic waves propagating in the easy plane and along the c-axis. Lowest theoretical phonon threshold was for transverse elastic waves propagating and polarized in the easy plane, and at frequencies

below the bottom of the spin wave manifold; this threshold dominated the theoretical second order off-resonance spin wave threshold. Theory was developed for growth of phonon instabilities from thermal level to relate pulse saturation effects to phonon absorption. Author

N65-24412# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EPR-SPECTRA OF GAMMA-BOMBARDED QUARTZ CRYSTALS ACTIVATED WITH GERMANIUM
S. V. Starodubtsev and Sh. A. Vakhidov 17 Dec. 1964 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Fiz.-Mat. Nauk (Tashkent), no. 6, 1963 p 46–50
(FTD-TT-64-591/1+2; AD-610420)

The addition of iron, aluminum, sodium, and germanium admixtures to crystalline quartz causes a considerable change in many physical properties of the crystal. The admixtures are adsorbed by various growth edges in quantitatively and configurationally different ways. In this report the radiation defects in quartz crystals activated by a germanium admixture are studied by the electron paramagnetic resonance method. It was established that after X-ray bombardment, specific electron paramagnetic resonance peaks originate. Additional experiments involving electro treatment methods under variations of thermal sample bombardment conditions were donducted to determine the kinetics and nature of radiation defects origination. The specificity of epr spectra obtained and the nature of luminescence, for various growth facets, confirm the conception about the sectorial distribution of quartz properties. R.S.

N65-24414# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MEASUREMENT OF SEMICONDUCTOR MINORITY CURRENT CARRIER LIFETIMES BY OBSERVING THE PHOTOCONDUCTIVE DECAY OF SPREADING RESISTANCE UNDER A POINT CONTACT
Shou-Wu Wang 29 Jan. 1965 28 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 19, no. 3, 1963 p 176–190
(FTD-TT-64-830/1+2+3+4; AD-610649)

A new method for measuring the lifetime of minority current carriers in semiconductors is described. Measurements are made by observing the photoconductive decay of the spreading resistance under a point contact. This method has the following advantages: (1) It is not necessary to cut the specimen to a special shape. (2) It is not necessary to make a fixed electrode for the specimen. (3) It is applicable for testing nonhomogeneous specimens. (4) No particular surface treatment is necessary. (5) The apparatus used is simple and easy to operate. (6) The technique delivers sufficient accuracy. A theoretical analysis of the effects of surface recombination rate and varying absorption depth of light in the specimen is given. Experimental details and discussion are given for Ge and Si specimens. The results are in good agreement with those obtained by other methods. Author

N65-24426# Franklin Inst., Philadelphia, Pa.
ELECTRONIC STRUCTURE OF DILUTE SOLID SOLUTION ALLOYS OF 3D-TRANSITION METALS IN A NON-MAGNETIC MATRIX Summary Report, 1 Jun. 1962–31 May 1964
F. T. Hedgcock, E. W. Collings, and W. B. Muir Wright-Patterson AFB, Ohio, AF Mater. Lab., Feb. 1965 29 p refs
(Contract AF 33(657)-8744)
(ML-TDR-64-163; AD-614482)

Electronic structure of dilute alloys was studied for Cu–Fe, Cu–Mn, Cu–Zn, Mg–Mn, Mg–Fe, Al–Mn, Zn–Mn, Mg–Al, Mg–Al–Mn and Ge–Sb. Electrical and magnetic measurements made (1) magnetoresistivity as a function of temperature below 4.2° K for superconducting, semiconducting and nonsuperconducting alloys; (2) resistivity as a function of temperature between 1.3° and 380° K; (3) magnetic susceptibility between room temperature and 4.2° K; (4) electronic spin resonance in the liquid helium temperature region; (5) de Haas-van Alphen effect measurements on single crystals, and (6) thermoelectric power below 4.2° K. Experiment indicated the electronic state of a paramagnetic ion dissolved in metal is not the same as in the isolated ion. It seems that some filling of the d-shell takes place and/or some polarization of the conduction electrons in the immediate vicinity of the paramagnetic ion is present. Resultant moment on the paramagnetic ion is sensitive to the conduction electron density as well as the degree of mixing of the d-state with the conduction electron states. These measurements further indicated that anomalies in the electron transport properties of normal metal alloys, superconductors and semiconductors which contain localized magnetic states are a result of the interaction of these local moments with the spin of the conduction electrons. Author

N65-24457# Boeing Scientific Research Labs., Seattle, Wash.
STATISTICAL THEORY FOR GRAIN BOUNDARY SELF-DIFFUSION IN METALS
C. M. Carlson Jan. 1965 55 p refs
(DI-82-0353)

A disordered liquidlike defect model for grain boundary self-diffusion in metals is described. This model is based upon a simple liquid lattice approach formulated for liquid metals in a previous document. The model assumed for the disordered defect in the grain boundary consists of four atoms which occupy six defect sites. It is shown that this model yields reasonable values for the energies of atoms in the region of the defect and the D_o factor in the expression for the coefficient of self-diffusion along the grain boundary. Author

N65-24521*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PADE APPROXIMANT CALCULATION OF THE SINGULARITY IN THE MAGNETIC SUSCEPTIBILITY OF AN ISING SQUARE LATTICE
A. V. M. Ferris-Prabhu Washington, NASA, Jun. 1965 15 p refs
(NASA-TN-D-2822) CFSTI: HC $1.00/MF $0.50

The Padé approximant method was applied to Clapp's spinspin correlation formulation for the magnetic susceptibility in an Ising square lattice, to investigate the nature of the critical point. For the exact cluster formulation it is found that as the cluster size increases, the critical point, namely the point at which the susceptibility has a singularity, approaches Onsager's exact value of 0.414, and that $\chi(t) \sim 1/(t - t_c)$. For the self-consistent formulation, 20 Padé approximants were calculated. Value of the critical point converged very rapidly to 0.41862770 and it was found that $\chi(t) \sim 1/(t - t_c)$. Author

N65-24551 Joint Publications Research Service, Washington, D. C.
RESONANCE BROADENING AND THE TRANSFER OF ENERGY IN OPTICALLY EXCITED SYSTEMS WITH A DISCRETE SPECTRUM
U. Kh. Kopvillem and V. R. Nagibarov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 261–264 refs
(See N65-24525 14-07) CFSTI: $7.00

A study of the effect of interactions $\hat{H}=\sum_{J>K}\hat{H}^{JK}$ on the shift and width of the optical resonance line between the states $^4A_2(1/2)$ and $\bar{E}(^2E)(-1/2)$ of the ion Cr^{3+} in a strong magnetic field is presented. Considered are electric dipole–dipole interactions due to the matrix elements of forbidden transitions between the states with identical parity, which appear in the case of combined action of the spin orbit coupling and the odd component of a trigonal crystal field. Included are mathematical computations of the first and second moments of the optical resonance line $E_1 \leftrightarrow E_2$ relative to the position of this line in the absence of perturbation H. Results of studies on resonance energy transfer at optical frequencies, due to direct dipole–dipole interactions and interaction through the photon–phonon field, show that the lifetime of the excited levels can be controlled by introducing other admixtures with suitable spectra and short longitudinal relaxation times. S.C.W.

N65-24595# Cambridge Univ. (England). Cavendish Lab.
A STUDY OF FERROELECTRIC MATERIALS Final Technical Report, 1 Oct. 1963–31 Dec. 1964
W. H. Taylor 30 Jan. 1965 23 p refs
(Contract DA-91-591-EUC-3055)
(AD-462725)

This report deals with the structure and lattice parameters of different phases of sodium niobate. Room temperature structure, a distorted pervoskite structure, was known approximately, but needed checking and refining. This was carried out using new data collected for four main zones and a number of layer lines. A complete description of all atomic positions was obtained. A new survey of lattice parameters of all phases from room temperature to about 800° C was carried out, supplementing earlier results, reassessing their accuracy and reproducibility, and making a critical analysis of the whole. Outstanding result is a recognition of the complexity of the system. On the whole our measurements agree with those in the literature, and confirm most of the transition temperatures reported by others. However, many conclusions drawn by these workers are now mistaken. A summary is given of evidence in the literature for the existence of a low-temperature phase, believed to have a region of thermal hysteresis from −50 to −200° C. Our work found no structural change down to −180° C. Author

N65-24651# Cambridge Univ. (England). Cavendish Lab.
CURRENT RESEARCH. REPRINT LIST AND ABSTRACTS OF RECENT PAPERS
F. P. Bowden et al 1964 19 p

Current research and abstracts of recent papers in surface physics, strength properties of solids, solid state physics, and decomposition in the solid state are reported. S.C.W.

N65-24654# Northwestern Univ., Evanston, Ill. Materials Research Center
MATERIALS RESEARCH CENTER ANNUAL REPORT, 1 FEBRUARY 1964–31 JANUARY 1965
[1965] 144 p refs
(Contract ARPA SD-67)
(AR-5)

Continued research in materials science, solid state physics, chemistry, electrical engineering, and civil and chemical engineering is reported. Included are comments on the research program; a list of publications, abstracts of talks, and degrees awarded in the field of materials; and reports of research conducted during the past year, such as: *Diffraction Studies of Materials, Polymer Studies, Boundary Value Problems in the Elastic Theory of Dislocations, Properties of High Temperature Materials, Sintering Kinetics, Lattice Imperfection Studies,* and *Electronic Structure and Thermodynamics of Alloys and Semiconductors.* S.C.W.

N65-24679# Iwate Univ., Morioka (Japan).
THE EDGE DISLOCATION AND CRYSTAL GROWTH OF CdS CRYSTALS
Jiro Nishimura *In* Tohoku Univ. Bull. of the Res. Inst. for Sci. Meas., Vol. 11, No. 2–3 Jan. 1963 p 189–203 refs (See N65-24675 14-15)

Results of density studies of etch pits in 0001 surfaces of CdS confirmed that two types of low-angle symmetric boundaries are present in CdS crystals which include (1) sets of parallel edge dislocations with Burger's Vector a $(1\bar{2}10)$ and slip plane $(10\bar{1}0)$, and (2) boundaries with Burger's Vector $\sqrt{3}\,a(10\bar{1}0)$ and slip plane $(1\bar{2}10)$. It was also found that asymmetric boundaries may be made up of two sets of type-1 edge dislocations with Burger's Vectors making 60° with each other. Results of experiments in which type-1 boundaries were introduced into CdS crystals during early growth, and during grain growth of adjoining crystals, indicate that since type-2 boundaries were present during the final stage of growth, they are more stable than type-1. It is presumed that type-1 subboundaries are introduced into crystals so as to lessen stress energy arising from crystal growth and grain growth. Author

N65-24680 Iwate Univ., Morioka (Japan).
THE VARIATION OF ELECTRIC RESISTANCE OF CdS AND ZnS CRYSTALS UNDER IRRADIATION WITH X-RAY
Jiro Nishimura *In* Tohoku Univ. Bull. of the Res. Inst. for Sci. Meas., Vol. 11, No. 2–3 Jan. 1963 p 205–226 refs (See N65-24675 14-15)

The variation of electric resistance of CdS and ZnS when irradiated by X-ray was measured with the crystals containing stoichiometric or nonstoichiometric components. The photoconductive response for X-irradiation is considerably modulated by the presence of excess Cd or Zn which behaves as traps of photoelectrons. The photoconductive properties of CdS crystals were studied in detail, and it is concluded that when large concentration of excess Cd is present in CdS, linearity does not always hold in the relation between photocurrents and X-ray intensities. Photocurrents consist of two components: one of fast rise and proportional to X-ray intensities, the other of slow rise and unproportional to the intensities. The latter component becomes larger as the concentration of contained Cd is larger. Author

N65-24682 Tohoku Univ., Sendai (Japan).
STUDY ON THE DIELECTRIC ANOMALIES PRODUCED BY THE PHASE TRANSITION
Kan-Ichi Kamiyoshi, Tadao Fujimura, and Tsutomu Yamakami *In its* Bull. of the Res. Inst. for Sci. Meas., Vol. 11, No. 2–3 Jan. 1963 p 235–248 refs (See N65-24675 14-15)

To establish a method for studying the phase transition of substances by observing dielectric properties, anomalies of dielectric properties produced by liquid ⇌ solid and solid ⇌ solid phase transitions were observed in several substances at frequencies of 100 c/s to 10 Mc/s. Studied were chloroform, toluene, n-hexane, cyclohexane, cyclohexanone, acetic acid, KNO_3, $AgNO_3$, $CsNO_3$, $TlNO_3$, $(NH_4)_2Cr_2O_7$, NH_4HSO_4, CH_3NH_3Cl, $Mg(NO_3)_2 \cdot 6H_2O$, $Cu(NO_3)_2 \cdot 3H_2O$ and $Cr_2(SO_4)_3 \cdot 15H_2O$. It was confirmed, that when the dielectric constant was measured as a function of temperature, it

had a discontinuity at the first-order phase transition, whereas it had a kink (continuity in dielectric constant but discontinuity in $\delta\epsilon'/\delta T$) at the second-order phase transition. In the case of cyclohexanone, however, the dielectric anomaly was observed below the freezing point because the dipole moments were frozen at lower temperatures. Acetic acid containing a small quantity of water showed an anomalous large dielectric constant below its freezing point. The above dielectric method was used to study phase transition of water adsorbed on silica gel or on solid surface. When a relatively small quantity of water (21 wt%) was adsorbed on silica gel, the state of adsorbed water gradually changed with the rise in temperature; when a large quantity of water (40 wt%) was adsorbed, the solid → liquid phase transition was observed at −38° C (for water condensed in capillaries), at −20° and at 0° C (for water fixed between grains). A very small quantity of water adsorbed on solids such as powdered $CsNO_3$, showed a large dielectric anomaly on heating at its solid → liquid phase transition. Author

N65-24698# National Bureau of Standards, Boulder, Colo. Radio Standards Lab.
DEMAGNETIZING FACTORS FOR OBLATE SPHEROIDS USED IN FERRIMAGNETIC RESONANCE MEASUREMENTS
L. B. Schmidt, W. E. Case, and R. D. Harrington 4 Sep. 1964 16 p refs
(NBS-TN-221) GPO: $0.20

Demagnetizing factors for oblate spheroids magnetized along the short axis are given for aspect ratios from 25.0 to 35.0 in increments of 0.1, from 35.0 to 55.0 in increments of 0.2, from 55.0 to 80.0 in increments of 0.5, from 80.0 to 129.0 in increments of 1.0. Values of all demagnetizing factors given were rounded off to 6 decimal places and are accurate to ±5 units in the seventh place. The tables are presented in a form convenient for use in ferrimagnetic resonance measurements on disk shaped samples. A brief discussion of the effect of accuracy of demagnetizing factors on measurements of this type is included. Author

N65-24700# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation
CASCADE AND CLUSTER: COMPUTER PROGRAMS TO SIMULATE RADIATION DAMAGE PROCESSES IN METALS AND ANALYZE THE DISTRIBUTION OF DEFECTS
D. G. Besco and N. R. Baumgardt Apr. 1965 50 p refs
(Contract AT(40-1)-2847)
(GEMP-356) CFSTI: $3.00

Presented is a self-contained set of instructions for the use of the modified, updated and combined Cascade and Cluster computer programs. This program searches the lists of vacancies and unstables for Frenkel pairs and removes them from the defect list; searches then for divacancies, diinterstitials, trivacancies, and clusters containing large numbers of vacancies and interstitials, and computes the distribution functions for the separation distance between pairs of defect types. The damage pattern which Cascade creates and from which Cluster removes the unstable Frenkel pairs can be used for new Cascade runs to study the saturated damage state. The programs are coded in Fortran II and FAP language and the execution is under control of the Fortran monitor system. G.G.

N65-24738# Atlantic Research Corp., Alexandria, Va.
DYNAMIC MECHANICAL PROPERTIES OF SOLID PROPELLANTS Final Summary Report, 23 Jun. 1961–31 Jul. 1963
15 Jan. 1964 43 p refs
(Contract NOw-61-1054-c; ARPA Order 22-61)
(AD-458444)

The objective was to define the dynamic shear properties of selected propellants between 25 and 2000 cps at −50° to 75° C and to 1000 psig. Measurements are conducted with an apparatus which applies a sinusoidal shear stress and strain to a propellant sample. Continuous smooth curves depicting compliance of propellants having a hydrocarbon binder and polyurethane binder as a function of frequency and temperature were constructed. Cure time of the hydrocarbon-type propellant was found to influence compliance measurements. Propellant cured under representative conditions of actual grains continued to change with time, particularly as the temperature was raised through a sequence of measurements, but propellant cured for longer lengths of time was stabilized. Small changes in moisture content were shown to effect compliance. Increasing static compressive strain normal to the shear plane appeared to decrease compliance markedly. Attempts to apply the method of reduced variables to these data was unsuccessful. Author

N65-24776# George Washington Univ., Washington, D. C. School of Engineering and Applied Science
STUDIES IN THE THEORY OF A DISLOCATED CONTINUUM Final Scientific Report
G. M. Arkilic Jun. 1964 19 p refs
(Grant AF-AFOSR-224-63)
(AD-614225)

Using curvilinear and anhalonomic coordinate systems, the most general forms of linear coefficients of connections and expressions for torsion and curvature are represented. These are the basic quantities that relate non-Riemannian spaces of differential geometry to the theory of dislocated continuum. With these special choices of coordinates, some quantities are obtained which could not have been retained on the less general systems. Considerable progress was made in the development of the displacement theory by use of the non-Riemannian geometry, and this approach should be useful in stress and displacement investigations. R.W.H.

N65-24777# Varian Associates, Palo Alto, Calif. Central Research Lab.
A STUDY OF SOLID STATE MICROWAVE DEVICES AND PHENOMENA (RESEARCH ON THE GUNN EFFECT) Interim Engineering Report, Oct.–Dec. 1964
H. Kroemer and G. F. Day Wright-Patterson AFB, Ohio. AF Avionics Lab., Jan. 1965 100 p refs
(Contract AF 33(657)-11015)
(IER-5; AD-462723)

This work is one of research on the Gunn effect. The simplest explanation of the Gunn effect is in terms of a time-independent negative differential bulk conductivity; this mechanism explains practically all known properties of the Gunn effect. An atomistic mechanism that can lead to a negative conductivity is based on the conduction band structure of GaAs. This negative conductivity leads to electrical breakup of the crystal into alternating traveling domains of high and low fields, accompanied by alternating current. First results of computer simulation of the effect are given. Current–voltage measurements were made on n-type GaAs samples having resistivities from 0.13 to 3900 ohm-cm. Samples with resistivities less than 200 ohm-cm showed abrupt onset of high frequency current oscillations at 1000 to 6000 V/cm with no significant change in rf amplitude at fields up to 24000 V/cm. Samples with resistivities of 1000 ohm-cm or greater showed

no oscillations below 8000 V/cm. At greater field strengths a time-dependent current increase was accompanied by a slow buildup of oscillations. These high resistivity samples were found to have current oscillations at frequencies about 200 000 times lower than Gunn oscillations under an applied field of about 1000 V/cm. These observations indicate that the Gunn effect is separate from previously observed low frequency oscillations in semi-insulating GaAs. Author

N65-24791# Radio Corp. of America, Princeton, N. J. RCA Labs.
UTILIZATION OF ORGANIC MATERIALS FOR MOLECULAR ELECTRONICS Final Report, 1 Jun.–30 Nov. 1964
S. E. Harrison, G. H. Heilmeier, J. Goldmacher et al Wright-Patterson AFB, Ohio, AF Avionics Lab., Feb. 1965 23 p refs
(Contract AF 33(657)-11662)
(AFAL-TR-65-32; AD-461315)

In this study of prototype solid-state devices containing organic materials, and in the determination of the electronic properties of these organic compounds, four projects are reported: I. Organic Thin-Film Devices, II. Organics as Photoconductors, III. Higher-Mobility Organic Semiconductors, and IV. Organic Molecular Crystals as Electro-Optic Modulators. Project I was an effort to obtain a thin-film transistor using the high-mobility organic semiconductor copper phthalocyanine. Studies of the production of good insulating films were performed. Project II carried the study of organic photoconductors to polymers doped with aromatic hydrocarbons. The doping of polymers appeared to have no effect on photoconduction. Project III concerned higher charge-mobility compounds. Ag^{2+} phthalocyanine was found to be physically intractable. Cobalt phthalocyanine showed promise as a high-mobility material. Under Project IV, the electro-optic coefficient of hexamine was measured by means of optical second-harmonic generation. The value obtained by this method, which is less sensitive to crystal perfection than that obtained through measurement of the Pockel's effect, is in excellent agreement with previous theory. A complete analysis is included. Author

N65-24828# Navy Electronics Lab., San Diego, Calif.
STRAIN PULSE PROPAGATION IN SINGLE CRYSTAL LEAD BARS Research Report, Mar. 1964–Feb. 1965
G. W. Grimm 18 Feb. 1965 39 p refs
(NEL-1266; AD-462068)

The nature of the strain pulse which is propagated along a single crystal bar when pressure is suddenly applied to one end of the bar is investigated. The character of the strain pulse was investigated over a narrow range of pressures intermediate between those pressures producing essentially elastic behavior and those resulting in large permanent deformation. Observations at pressures up to 500 psi were carried out in both polycrystalline cast bars and single crystal bars of lead. The shape of the strain pulse was determined at two widely separated positions along each bar. From these strain–time records, quantitative measurements were made of the velocity of the pulse and the magnitude of the final strain level. Theoretical values for Young's modulus in an anisotropic elastic bar were calculated and found to be in good agreement with the measured values. N.E.A.

N65-24969# California Univ., Berkeley. Lawrence Radiation Lab.
SUPERCONDUCTIVITY IN SOLID SOLUTIONS OF TRANSITION METAL CARBIDES
Molly Wells (M.S. Thesis) Jun. 1964 31 p refs
(Contract W-7405-ENG-48)
(UCRL-11368) CFSTI: $0.75

In crystal structures favorable to superconductivity in intermetallic compounds, successful empirical studies were made relating lattice parameter, electrons per atom, and electrons per unit volume to the superconducting transition temperature. The system of solid solutions of TaC and NbC was studied to ascertain whether similar empirical correlations existed for the cubic NaCl structure. Critical temperature showed a maximum higher than the critical temperature of either pure carbide. In this system, electrons per atom remained constant, while lattice parameters varied linearly. The results show that the parameters successfully applied to intermetallic compounds are insufficient to describe superconductivity in the cubic NaCl system. Author

N65-25000*# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Engineering and Science
INFRARED PROPERTIES OF 40–60 MEV ELECTRON-IRRADIATED GERMANIUM
J. F. Becker and J. C. Corelli [1965] 12 p refs
(Grant NsG-290)
(NASA-CR-62883) CFSTI: HC $1.00/MF $0.50

The annealing of defect infrared bands induced by 40- to 60-Mev electrons in low oxygen (less than 10^{16} per cc) and high oxygen (greater than 10^{17} per cc) containing single crystal germanium is reported. The characteristics of the germanium samples studied together with the incident electron energy, resistivity values before and after irradiation, total integrated fluxes, and sample thicknesses are given. Annealing experiments were performed in an electric furnace using silicone oil as the heat transfer medium for anneals up to 290° C. For anneals above 300° C, air served as the heat transfer medium. Temperature during anneal was controlled to ±1.° C in the oil bath and to ±3° C when air was used as the heat transfer medium. Also, the infrared spectra in the region 600 to 900 cm^{-1} of n-type germanium (oxygen concentration before irradiation was 1.2×10^{17} per cc) after various 20-minute anneals are shown. The spectra was measured at 80° K. No radiation-induced defect absorption bands were observed after 410° C anneals. Further, isochronal annealing indicated at least four annealing temperatures were indicated at about 160°, 220°, 320°, and 400° C. It is possible that the four temperature ranges correspond to different configurations of single and multiple vacancies coupled to oxygen atoms. E.E.B.

N65-25024# Iowa State Univ. of Science and Technology, Ames.
MEASUREMENTS OF SOME INTERNAL CONVERSION USING COEFFICIENTS SCINTILLATION COUNTER, COINCIDENCE TECHNIQUES
Ronald S. Dingus, W. L. Talbert, Jr., and E. N. Hatch Feb. 1965 133 p refs
(Contract W-7405-ENG-82)
(IS-1032) CFSTI: $4.00

Internal conversion coefficients were measured by observing with a well-type NaI(Tl) crystal the photon spectra emitted during the deexcitation from the first excited state to the ground state of Gd^{154}, Dy^{160}, Yb^{170}, Yb^{171}, and Pr^{141} following the respective beta decays of Eu^{154}, Tb^{160}, Tm^{170}, Tm^{171}, and Ce^{141}. The results were obtained by analysis of either the singles spectra, or spectra obtained by coincidence-sum techniques, or both. The following K-shell internal conversion coefficients were measured directly for first excited state to ground state transitions: 0.632 ±0.016, for Gd^{154}; 1.48 ±0.05, for Yb^{170}; 6.9 ±1.0, for Yb^{171} and

0.375 ±0.009, for Pr^{141}. The total internal conversion coefficients were measured for the first excited state to ground state transitions in Gd^{154} and Dy^{160} and found to be 1.20 ±0.02 and 4.52 ±0.11, which yield respective K-shell internal conversion coefficients of 0.637 ±0.016 and 1.54 ±0.06 when multiplied by K to total ratios. The results for these $2^+ \rightarrow 0^+$ transitions in Gd^{154} and Dy^{160} and for this *l*-forbidden MI transition in Pr^{141} are in good agreement with theory. The ratio of the experimental result to the theoretical value is 1.09 ±0.06 for this $2^+ \rightarrow 0^+$ transition in Yb^{170}. The result for this MI + E2 transition in Yb^{171} implies a mixing ratio of E2/MI = 0.45 ±0.09, assuming the theoretical internal conversion coefficients are correct. Author

N65-25131 Lockheed Missiles and Space Co., Palo Alto, Calif. Electronic Sciences Lab.
ELECTRONIC STRUCTURE OF CRYSTALS
F. Herman, R. L. Kortum, C. D. Kuglin, and R. A. Short *In its* Progr. Rept., Jan.–Mar. 1965 [1965] 4 p refs (See N65-25125 14-34)

A theoretical investigation to elucidate the electronic energy band structure of crystalline solids and to determine many of the physical properties of crystals and alloys which depend on the energy level scheme is discussed. The method of approach was to solve the crystal wave equation for all important electronic energy levels and wave functions. The original electron exchange model was replaced by a more sophisticated and realistic model which takes the electron correlation effects into account by suitably screening the exchange interaction. Also, relativistic corrections were included in the energy band program. The physical reliability of the approach was checked by carrying out detailed calculations for a number of materials whose band structures are well known. The improved physical model which takes electron exchange, correlation, and relativistic effects into account now yields results which compare favorably with experiment. E.E.B.

N65-25132 Lockheed Missiles and Space Co., Palo Alto, Calif. Electronic Sciences Lab.
RELAXATION TIME AND INTERACTION WITH ULTRASONICS OF RARE EARTH IONS IN CaF_2
W. Dobrov *In its* Progr. Rept., Jan.–Mar. 1965 [1965] 6 p refs (See N65-25125 14-34)

The ion-acoustic wave interaction was studied experimentally with longitudinal waves by bonding a sample of doped CaF_2 to quartz rods or plates in which 10 Gc acoustic waves were generated. The paramagnetic spectrum was previously recorded and the magnetic field was varied over the range of the spectrum while observing the amplitude of the transmitted acoustic pulses. When the relationship between acoustic frequency and the magnetic field satisfies the magnetic resonance condition, a decrease of acoustic frequency is observed if the interaction is sufficiently strong. If the magnetic resonance region is covered and no magnetically dependent absorption is observed, the upper limit of the ion-acoustic wave interaction can be established from the limit of the experimental sensitivity. The longitudinal waves experiments were performed for different directions of propagation and magnetic field orientation, but in all cases only the upper limits of the absorption coefficients were determined. It was concluded that the present theory should be modified to permit the predominance of multiphonon processes at low temperature and the relaxation time due to these multiphonon processes should vary as T^{-1}. E.E.B.

N65-25133 Lockheed Missiles and Space Co., Palo Alto, Calif. Electronic Sciences Lab.
SHEAR AND LONGITUDINAL MAGNETOELASTIC WAVES IN TRANSVERSELY MAGNETIZED RODS
R. L. Comstock and P. E. Wigen *In its* Progr. Rept., Jan.–Mar. 1965 [1965] 4 p refs (See N65-25125 14-34)

The Schlömann and Joseph analysis of the coupling of shear elastic waves and spin waves in a finite axially magnetized rod oriented along the hard (100) axis was extended to include longitudinal as well as shear elastic waves by considering the transversely magnetized rod oriented with the magnetic field along the easy (111) axis with propagation along the rod axis. The wave numbers of the spin waves and shear and longitudinal elastic waves in the axially and transversely magnetized rods are shown. Under certain approximations, the Schlömann and Joseph analysis can be applied to the solution of the present problem with modifications in the coupling constants and elastic moduli. In the transversely magnetized ($\bar{1}10$) rod, a longitudinal elastic wave can be converted into a spin wave and the spin wave converted into a shear elastic wave, i.e., the system can operate as a longitudinal-to-shear wave converter. E.E.B.

N65-25134 Lockheed Missiles and Space Co., Palo Alto, Calif. Electronic Sciences Lab.
MAGNETOELASTIC WAVE PARAMETRIC INSTABILITY ANALYSES
R. L. Comstock and E. R. Hansen *In its* Progr. Rept., Jan.–Mar. 1965 [1965] 3 p refs (See N65-25125 14-34)

The dispersion relation (ω vs k) for magnetoelastic waves and uncoupled spin and elastic waves is given. In the proposed instability, a wave on the lower branch of the magnetoelastic spectrum at angular frequency ω_1 is coupled to a wave on the upper branch at ω_2 with an equal but opposite value of k. The pump frequency ω_p is the sum of ω_1 and ω_2. It was found that the nondegenerate instability was favored over the degenerate instability (waves at $(\omega_p/2)$ whenever $\omega_p > \omega_{p,crit} = v_s^2/\gamma D$, where v_s is the shear wave velocity, γ is the gyromagnetic ratio, and D is the exchange field. Values of $\omega_{p,crit}$ for several ferromagnetic insulators are shown. It appears that the gallium doped europium iron garnet offers the best possibility for observing the nondegenerate instability. E.E.B.

N65-25135 Lockheed Missiles and Space Co., Palo Alto, Calif. Electronic Sciences Lab.
FERROELECTRICS
R. M. Hill, S. K. Ichiki, and J. G. Little *In its* Progr. Rept., Jan.–Mar. 1965 [1965] 6 p refs (See N65-25125 14-34)

Study of the domain structure of KH_2PO_4 and the optical effects which result therefrom continued. Major attention was given to optical propagation nearly normal to the domain walls. For plane polarized light, a pronounced scattering between the two normal forward modes of the material which was strongly wavelength dependent was observed. The domain configuration is shown. The orthorhombic axes alternate from domain to domain and are at almost 45° to the x, y axes which are the crystal axes when $T > T_c$. The experiment and analysis were restricted to propagation in the x, c plane at a small angle θ between x and the directions of propagation. Data are given for a KH_2PO_4 crystal 1 cm on a side. When a thin 0.5-mm crystal was used, only one or two peaks in the perpendicular component were found. When $\theta = 0$, i.e., when propagation was along x, no perpendicular component was observed. E.E.B.

N65-25219# Hewlett-Packard Co., Palo Alto, Calif.
SEMICONDUCTOR OPTOELECTRONIC PHENOMENA INVESTIGATION Interim Engineering Report, 28 Dec. 1964–31 Mar. 1965
[1965] 84 p refs
(Contract AF 33(615)-2388)
(IER-1; AD-463463)

Properties of GaAs injection electroluminescent diodes, and factors that determine internal quantum efficiency, η_o, are reviewed. A significant increase in η_o is described that results from lowering the Zn concentration in the diffused p-skin by using dilute solutions of Zn in Ga as diffusion sources. External efficiencies of 1.7% were obtained for light emanating from one side of a mesa-type plane parallel slab diode at room temperature. Found to limit efficiency are (1) short nonradiative lifetime that varies from crystal to crystal and depends on the method of diffusion; (2) minority carrier collection at contacts; (3) long radiative lifetimes in a region of the p-skin adjacent to the junction; and (4) surface recombination. Data on the V-I light output characteristics of the new diodes are presented. The surface component of current is smaller initially than in previous diodes, but the current induced change, is greater. The state of the art of evaporating silica films onto GaAs for use as diffusion masks, insulating layers, and surface protectors during diffusion is reported. Glasses of the Tl–As–S and As–S–Se system were made and characterized for properties pertinent for use as optical coupling media. A pulser that samples a constant dc current to obtain accurate current pulses utilizing photon-coupled isolators was designed and built. Use of the isolator with standard transistors to obtain photon-coupled isolation with high gain-bandwidth product is analyzed and detailed electrical characterization of such devices presented. Author

N65-25222# Naval Ordnance Lab., White Oak, Md. Applied Physics Dept.
SOLID STATE RESEARCH FOR THE YEAR 1964
Louis R. Maxwell, ed. Jun. 1965 69 p refs
(NOLR-1260; AD-463003)

Continued studies in solid state research, magnetism, and metallurgy are reported. Results of research in the following areas are included: magnetic spin lattice properties, neutron diffraction, environmental magnetic studies, magnetic devices, surface effects, magnetoresistance, thin film studies, optical properties of semiconductors, transport properties, elastic properties, intermetallics, and transmission of laser light through water. Also cited are reports and publications, and papers presented at meetings. S.C.W.

N65-25225# General Dynamics/Electronics, Rochester, N. Y. Physical Electronics Lab.
THIN FILM MEASUREMENT TECHNIQUES Final Report, Jul. 1963–Aug. 1964
Carl E. Drumheller Wright-Patterson AFB, Ohio, AF Avionics Lab., Dec. 1964 78 p refs
(Contract AF 33(657)-8753)
(AFAL-TR-64-288; AD-614891)

An advance in the current density measurement of electron tunneling in aluminum oxide was made. The structure is an Al–Al_2O_3–Al thin-film diode. In these devices a current density measure of 242 A/cm^2 resulted from modifications in measurement technique. Previously reported voltage-current and temperature-conductivity measurements support the belief that this tunnel current is due to the presence of traps. Recent photoemission measurements have strengthened this belief. Some properties of anode luminescence in aluminum oxide were observed. Electrical and optical properties of thin-film copper were investigated. The anomalous result obtained, that transmittance of radiation is greater for the thicker film than for the thinner film, is a further confirmation of the tunneling model for grain-boundary scattering in polycrystalline metal films. The photoemission measurements, quantum tunneling calculations, the anode luminescence study of aluminum oxide, the optical measurements of thin polycrystalline copper films, and a charge versus voltage display are discussed. Author

N65-25263# Illinois Univ., Urbana. Dept. of Physics
SURFACE STUDIES USING THE MOSSBAUER EFFECT
J. W. Burton, H. Frauenfelder, and R. P. Godwin [1964] 28 p refs
(Contract AF 49(638)-1048)
(AD-615082) CFSTI: HC $2.00/MF $0.50

Some basic aspects of the Mössbauer effect theory are discussed, the experimental approach is reviewed, and several experimental results are evaluated. A model of a simple-cubic lattice is given as example, and it is shown that the mean square displacement of a surface atom is greater when perpendicular than when parallel to the surface for an atom situated in the surface, while it is smaller for an atom situated on the surface. Also indicated are several models used in calculations of the effects of free crystal surfaces on atomic mean square displacements. The electrical quadrupole splitting of the nuclear energy levels was used to study the electric field gradients at surfaces of the Mössbauer isotope Fe^{57}. The Mössbauer effect of Fe^{57} on the surface of polycrystalline tungsten was measured at temperatures from 100° to 500° K in an ultrahigh-vacuum system, and analysis indicated three unresolved lines for the spectrum. The middle line was attributed to Fe^{57} in the bulk of tungsten, and the outer two to surface effects. It was concluded that the Mössbauer effect with its ability to sense electric and magnetic fields, electron charge densities, and details of lattice bonds seems suited for surface studies. G.G.

N65-25288# Bureau of Mines, College Park, Md. Metallurgy Research Center
THERMOELECTRIC PROPERTIES OF DEPLETED URANIUM SELENIDES AND TELLURIDES
Lindsay D. Norman, Jr. 1965 22 p refs
(BM-RI-6638)

Thermoelectric properties of depleted uranium selenides and tellurides were investigated from room temperature to 700° C. Several depleted uranium monoselenides and monotellurides were doped with selected cationic and anionic materials to determine the effect of impurity additions on the thermoelectric properties. The undoped uranium selenides and tellurides were semimetallic conductors exhibiting low Seebeck coefficients and electrical resistivities. Partial or complete degeneracy was in evidence, indicating a charge carrier energy distribution similar to that in a metal. Doping increased the Seebeck coefficients of the uranium monoselenides and monotellurides; however, the corresponding change in the power factor in the figure of merit was small because of the increase in electrical resistivity. Author

N65-25301# Uppsala Univ. (Sweden). Quantum Chemistry Group
CRYSTALLITE SIZE DISTRIBUTIONS FROM X-RAY POWDER LINE PROFILES
Vedene H. Smith, Jr. and Paul G. Simpson (Ga. Inst. of Technol.) 15 Jun. 1964 11 p refs *Its* Preprint No. 118
(Contract AF 61(052)-701)

The distribution of column lengths, $P^{(n)}/N_c$, in a powder sample is given by the relationship

$$P^{(n)}/N_c = K(A_{n+1} - 2A_n + A_{n-1})/(A_1 - A_{k+1})$$

among the Fourier coefficients of the X-ray powder diffraction line shape under the assumption that the total number of columns of length one, two, to k unit cells is negligibly small. This eliminates the necessity for use of the experimentally imperfect coefficient A_0 and is equivalent to Warren's method for elimination of the "hook effect." Author

N65-25304# International Union of Crystallography. Commission on Crystallographic Apparatus
HIGH-TEMPERATURE X-RAY DIFFRACTION TECHNIQUES, BIBLIOGRAPHY 1
H. J. Goldschmidt (B. S. A. Res. Centre) 1964 21 p
Available from Nivia. Oostaoek's Uitgevers Mij, Utrecht: $3.00

An annotated bibliography on high-temperature X-ray diffraction techniques is presented that is subdivided into photographic techniques, and diffractometer techniques. The order is chronological and data are given for the author, reference, and brief details. Only papers dealing with equipment and methods are included. G.G.

N65-25355# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
OBSERVATIONS ON THE THERMAL CONDUCTIVITIES OF CERTAIN PARTIALLY-REDUCED CERAMIC OXIDES
J. E. May and R. L. Stoute Jan. 1965 49 p refs
(AECL-2169) Available from Atomic Energy of Canada, Chalk River: $1.50

Thermal conductivities of small ceramic specimens were compared in pairs using a simple apparatus that yields only qualitative results. Comparisons apply for mean temperatures up to 1200° C. That partial reduction can enhance the thermal conductivity of UO_2, was confirmed. Possible differences of emissivity between paired specimens were eliminated by depositing surface coatings on both. Continued difference of specimen temperatures under these conditions demonstrated that differences in specimen conductivity were responsible. Conductivity of a single crystal was greater than that of a polycrystalline sinter (both stoichiometric), but the improvement was less than achieved by reducing the sinter to $UO_{1.98}$. A similar dependence of thermal conductivity on composition was found for ThO_2. (Th, U)O_2 and ZrO_2. Observations on MgO, Al_2O_3 and TiO_2 were inconclusive. Additions of the order of 0.1 mole% Y_2O_3, La_2O_3, TiO_2, ZrO_2 or Nb_2O_5 were made to UO_2 and the effect of partial reduction on the conductivity studied. All gave results generally similar to pure UO_2, but with the first two additives increased thermal conductivity occurred at lower temperatures. Addition of Y_2O_3 to ThO_2 had a similar beneficial effect. Author

N65-25413# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
MAGNETIC ANISOTROPY FIELDS IN SINGLE-CRYSTAL IRON GARNETS Physical Sciences Research Papers, No. 79
Peter D. Gianino Feb. 1965 44 p refs
(AFCRL-65-77; AD-613052)

Measurements of the temperature dependency of first- and second-order anisotropy fields, as well as g-factors, were made on single crystal iron garnets of yttrium, lutetium, gallium–yttrium, and indium–yttrium. Unit formulas are denoted by $Y_3Fe_5O_{12}$, $Lu_3Fe_5O_{12}$, $Y_3Fe_{5-x}Ga_xO812$, and $Y_3Fe_{5-x}In_xO_{12}$, respectively. Results show that at any given temperature, first-order anisotropy fields within the yttrium iron garnet are enhanced by substitution of gallium and diminished by that of indium; for any given sample, these fields increase as temperature is lowered. Low temperature anisotropy fields for lutetium iron garnet, at variance with those previously reported, are as expected. However, the anisotropy surface of lutetium iron garnet is highly convoluted at liquid helium temperatures. There is evidence that anisotropy fields are independent of sample size effects. No experimental evidence of effects due to an external electrostatic field or of thermal hysteresis could be detected. Secondary peaks observed superimposed on the principal resonance absorption curve of some of the samples over many temperatures are noted. Derivations are given of the cubic system anisotropy energy and Kittel's effective demagnetization factors in the {110} plane up to third order. Author

N65-25421# Parke Mathematical Labs., Inc., Carlisle, Mass.
THERMAL EFFECTS IN RADIATION DAMAGE EXPERIMENTS Scientific Report No. 4
Charles H. Sherman Oct. 1964 40 p refs
(Contract AF 19(628)-2419)
(AFCRL-64-935; AD-612810)

Calculation of the one-dimensional steady-state temperature distribution in a radiation damage test strip is described. The analysis includes the temperature dependence and specimen dependence of the thermal conductivity, as well as the effect of radiation damage on the thermal conductivity. The thermal calculations are used to determine the electrical resistance of the sample during irradiation, and various uses for such calculations in interpreting experimental data are discussed. Numerical illustrations are carried out for a platinum sample. Author

N65-25442# Varian Associates, Palo Alto, Calif. Central Research Lab.
HETEROJUNCTION DEVICE CONCEPTS Interim Engineering Report No. 1, Aug.–15 Oct. 1964
H. Kroemer Nov. 1964 24 p refs
(Contract AF 33(615)-1988)
(AD-460967)

In a heterojunction, numerous properties are different on the two sides of the junction, in addition to the differences that exist already in homojunctions. A catalog of possible differences was drawn up, for purposes of a complete examination. Two categories in that catalog were examined in detail: differences in energy band symmetry, and differences in impurity solubility. The former led to a concept for a new type of junction, the Chi-junction, a junction with a momentum, rather than an energy-barrier. The second led to some technological ideas for microelectronic devices, particularly tunnel diodes and resistors. Author

N65-25443# Texas Instruments, Inc., Dallas. Semiconductor Exploration Lab.
COMPOUND SEMICONDUCTOR FUNCTIONAL ELECTRONIC BLOCKS Quarterly Progress Report No. 2, 15 Mar.–15 Jun. 1964
Robert W. Haisty et al [1964] 48 p
(Contract AF 33(615)-1275)
(TI-08-64-96; AD-460931)

Doping effects of the transition metals in GaAs were investigated to determine the best choice of dopant for making

semi-insulating GaAs for epitaxial substrates and isolating layers. Results of the investigation showed that chromium is clearly the most promising dopant for this purpose. Further doping studies to determine the best way of introducing chromium into epitaxial deposits were made. Prototype FEB-compatible transistors were built and evaluated. These transistors were mesa structures fabricated in an n epitaxial layer on an n+ substrate with all three connections on the top surface. A logic network was chosen for the functional electronic block circuit. A breadboard version was built and partially evaluated. Some of the conditions which affect the zinc diffusion process were studied. Complete masking of manganese diffusions by sputtered SiO_2 films was observed. Author

N65-25537# Lincoln Lab., Mass. Inst. of Tech., Cambridge.
SOLID STATE RESEARCH, 1 OCTOBER–31 DECEMBER 1964
23 Mar. 1965 75 p refs
(Contract AF 19(628)-500)
(ESD-TDR-65-31; AD-613961)

Topics covered are *Solid State Device Research, Laser Research, Materials Research, Band Structure and Spectroscopy of Solids,* and *Magnetism and Resonance.* Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N65-24439# Southwest Research Inst., San Antonio, Tex.
EFFECT OF ADDITIVES ON THE STORAGE STABILITY OF HIGH-TEMPERATURE FUELS Final Technical Report, 15 Jun. 1963–14 Nov. 1964
Robert K. Johnston and E. L. Anderson Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Dec. 1964 133 p refs
(Contract AF 33(657)-11246)
(RS-433; AFAPL-TR-64-142; AD-454998)

A study was made of the use of additives to prevent or retard the deterioration of JP-6 fuel thermal stability during storage. Fuel-additive blends were stored at 130° F in sealed 15-gallon steel drums for periods up to 16 weeks. Thermal stability was measured by means of a modified fuel coker, using helium pressurization instead of a fuel pump. The standard ASTM-CRC fuel coker and the Eppi-CRC modified fuel coker were found to be unsuitable for this purpose, owing to contamination of the test sections with pump wear debris. A total of 52 additives were submitted for evaluation, from which 19 were selected by screening tests for inclusion in the hot-room storage program. Three JP-6 fuels were used as the base stocks for additive evaluation. Under storage conditions giving a 100° F decrease in base-fuel thermal stability, four additives or combinations of additives were found to be effective in maintaining thermal stability. These results indicate that the use of additives is a feasible approach to solving current problems in this area. Author

N65-24795# Stauffer Chemical Co., Richmond, Calif. Richmond Research Center
HIGH ENERGY OXIDIZERS Quarterly Technical Summary Report, 1 Aug.–1 Nov. 1964
K. O. Christe, J. P. Guertin, and A. E. Pavlath [1964] 25 p refs
(Contract Nonr-4019(00); ARPA Order 399-62)
(AD-609025)

The difluorohypochlorite anion, i.e., ClF_2^-, a new oxidizer species based on chlorinefluorides, was successfully prepared from nitrosylfluoride and chlorinemonofluoride. The complex is a white crystalline solid, which has a 100-mm dissociation pressure at −51°, and exhibits oxidizing properties. Its composition was established by analysis, molecular weight determination and infrared spectroscopy. It dissociates into the starting materials, NOF and ClF. From a pressure–temperature curve a heat of dissociation of 15.5 kcal $mole^{-1}$ was obtained. Conductivity measurements proved that the complex is ionic. Low-temperature infrared spectra of the solid complex showed that the structure, $NO^+ClF_2^-$, must be assigned to the complex. The ClF_2^- anion belongs to the space group D∞h, and therefore, the most probable structure is a trigonal bipyramid (sp^3d-hybrid) with the chlorine atom at the center, the two fluorine atoms at the apexes and the three free electron-pairs at the remaining corners. Author

N65-24799# Stauffer Chemical Co., Richmond, Calif.
HIGH ENERGY OXIDIZERS Second Annual Technical Summary Report, Feb. 1, 1964–Jan. 31, 1965
Karl O. Christe, J. P. Guertin, and A. E. Pavlath [1965] 53 p refs
(Contract Nonr-4019(00); ARPA Order 399-62)
(AD-612661)

The completed structural investigation of the difluorochlorinium cation, ClF_2^+, proved it is bent and not linear. Synthesis of difluorochlorinium complexes containing high-energy anions was approached from different directions. New oxidizer species based on chlorine fluorides, the difluorochlorate (I) anion, ClF_2^-, was prepared in the form of its nitrosyl salt. Nitrosyl fluoride reacts with chlorine monofluoride in a 1:1 mole ratio, forming a white solid at −78°, which is completely dissociated in the gas phase at 25°. A heat of reaction, 15.5 kcal $mole^{-1}$, is given for the dissociation process: complex (s) = NOF (g) + ClF (g). The complex is ionic in solution and solid state. The structure, $NO^+ClF_2^-$, is assigned to the solid complex, the ClF_2^- anion (point group D∞h) having a probable trigonal bipyramidal structure (sp^3d-hybrid) with the chlorine atom at the center, two fluorine atoms at the apexes, and three free electron-pairs at remaining corners. Nitrogen trifluoride, AsF_5, and elementary fluorine under different reaction conditions failed to produce the desired $NF_4^+AsF_6^-$. Author

N65-24816# Monsanto Research Corp., Everett, Mass. Boston Lab.
PHYSICAL AND RHEOLOGICAL PROPERTIES OF NITROSO RUBBERS Quarterly Report No. 6, 25 Sep.–24 Dec. 1964
G. L. Ball, III, H. S. Wilson, I. O. Salyer, L. Gilman, and J. V. Pustinger 14 Jan. 1965 20 p refs
(Contract DA-19-129-AMC-151(N))
(MRB-4013Q6; AD-461425)

Four nitroso gum samples were characterized by ir, nmr, elemental analysis, intrinsic viscosity, X-ray diffraction, tga, dta, and Clash–Berg shear modulus. Infrared analyses indicated that the four gums were basically similar. The nmr confirmed a previously reported structure of

$$[-N(CF_3)-CF_2CF_2-O-]_x$$

Elemental analysis, however, indicated a variation in fluorine content from 61% to 67%. Molecular weights by intrinsic viscosity were in the range of 1.0 to 1.3 $\times 10^6$. The tga confirmed

a previously disclosed weight loss at 75° C with unzipping at 260° C. The dta exhibited a mild exotherm at 250° C, with an explosive exotherm at 295° C. Glass transitions of −60° C and −45° C were found by means of the Clash–Berg shear modulus apparatus. However, it was felt that the −60° C transition may be due in part to the presence of solvent. Author

N65-24822# California Inst. of Tech., Pasadena. Firestone Flight Sciences Lab.
SOLID ROCKET STRUCTURAL INTEGRITY ABSTRACTS, VOL. II, NO. 1
A. R. Zak and R. A. Westmann, ed. Jan. 1965 84 p refs
(Contract AF 04(611)-9572)
(AD-612261)

CONTENTS:

1. RUPTURE OF ELASTOMERS AND PROPELLANTS
R. F. Landel p 1–22 refs (See N65-24823 14-18)
2. MECHANICAL CHARACTERIZATION p 24–38
3. THERMAL CHARACTERIZATION p 39
4. OPTICAL CHARACTERIZATION p 40
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N65-24982*# Atlantic Research Corp., Alexandria, Va.
A THEORETICAL MODEL FOR PREDICTING ALUMINUM OXIDE PARTICLE SIZE DISTRIBUTIONS IN ROCKET EXHAUSTS
Harvey L. Fein [1964] 25 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950227)
(NASA-CR-63104) CFSTI: HC $1.00/MF $0.50

The model is derived to describe the oxide particle size distribution obtained from internal burning, cylindrically perforated, aluminized, solid propellant grains. Particle growth is assumed to occur by diffusion of gaseous aluminum and aluminum oxides to the particle surface followed by a heterogeneous reaction to form condensed oxide, the overall rate being proportional to a concentration driving force and the particle area. The particle nucleation rate is assumed constant. Excellent agreement is obtained between experimental particle size distributions and the distributions predicted by the model. This agreement implies that the distribution is independent of chamber length and possibly chamber diameter, and depends upon only one arbitrary parameter characteristic of the nucleation rate. In terms of the number average particle volume, V_n, the normalized frequency, f(v), for the distribution is given by

$$f(v) = v_n 1/3_{(6v/}2/3 \exp[-(6v/V_n)^{1/3}]$$

Further conclusions are that oxide condensation progresses to equilibrium in the chamber, and that the nucleation mechanism is not homogeneous for aluminized propellants. Author

N65-25251# Goodyear Tire and Rubber Co., Akron, Ohio.
PROPELLANT ADHESIVES RESEARCH Final Report, 1 Feb.–20 Dec. 1964
H. M. Rice 5 Jan. 1965 39 p refs Prepared for Hercules Powder Co.
(Rept.-19-418)

This project was concerned with acquisition of information concerning solvation tendencies of good case bond (DBP) adhesives and with development of nonhazardous, generally usable laboratory methods for screening DBP adhesive prospects. Thirty-nine liquids composed of one or more solvents or plasticizers were investigated. Certain of these appear to have the same solvating effects upon many elastomers and resins as does live casting solvent, and can be used to select potential adhesives for bonding double-base propellants to various substrates. Other methods developed for identifying potential adhesives are described. Author

N65-25294# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science
THEORETICAL PERFORMANCES OF HYPERGOLIC PROPELLANT DIMAZINE–CHLORINE TRIFLUORIDE SYSTEMS
Akira Iwama, Kiroku Yamazaki, and Ken Kikuchi Feb. 1965 15 p refs
(ISAS-395, Vol. 30, No. 4)

The results of calculation for the theoretical performance and various thermodynamic data of Dimazine–chlorine trifluoride propellant system and Dimazine: hydrazine (1:1)–chlorine trifluoride propellant system were presented. The maximum theoretical specific impulse of Dimazine–chlorine trifluoride propellant system is 199.73 sec at mixture ratio of 5.75 (P_c=20 atm), and that of Dimazine: hydrazine (1:1)–chlorine trifluoride propellant system is 216.33 sec at mixture ratio of 3.575 (P_c=20 atm). Author

N65-25420# Bureau of Mines, Bartlesville, Okla. Bartlesville Petroleum Research Center
STORAGE STABILITY OF HIGH TEMPERATURE FUELS
Marvin L. Whisman and C. C. Ward Wright-Patterson AFB, Ohio, AF Aero-Propulsion Lab., Feb. 1965 91 p refs
(Contract DO (33-615)-64-1009)
(AFAPL-TR-65-13, Pt. I; AD-612468)

Modification of a 5-ml bomb test equipment and method shows promise of permitting precise measurement of labeled fuel components that contribute to deposits during thermal stressing. Three test methods were developed and evaluated for separation and measurement of radioactivity contributed to deposits and gums by selected fuel constituents. One technique that used the principle of liquid–solid chromatography as the separation process followed by liquid scintillation counting of the radioactive reaction products lacked sensitivity and resolution. The other methods employed gas–liquid chromatography for separation and both ionization chamber counters and liquid scintillation radioassay techniques. Evaluation showed chromatographic separation procedures were adequate but quantitative recoveries of gum from the apparatus were dependent upon the radioisotope and fuel system. Migratory nature of tritium under severe thermal stress was investigated with the hope of broadening the selection of radioisotopes available to these investigations. Tritium was found to exchange between nonreactive molecules to a significant extent at elevated temperatures and pressures. Author

N65-25439# Radiation Applications, Inc., Long Island City, N. Y.
RADIATION-INDUCED SOLID PROPELLANT DECOMPOSITION
28 May 1964 7 p
(Contract AF 49(638)-1125)
(AD-461462)

Continued research in radiation induced solid propellant decomposition, which focuses on solid ammonium perchlorate radiolysis and the ballistics properties of operational propellants, is reported. Discussed is the use of a laboratory burner that permits studies of both and solid oxidizer component burning with a carefully controlled gaseous fuel environment and the solid fuel component burning with a carefully controlled gaseous oxidizer environment. Preliminary results of deflagration studies of ammonium perchlorate, polystyrene, and polymethyl methacrylate are reported. Also cited are continued studies on the role of impurities on the apparent sensitivity of irradiation-induced acceleration of the ammonium perchlorate deflagration rate on the source of supply; the possibility of duration between fabrication and radiation exposure of the burners and their ultimate deflagration as a modifier of the irradiation-induced acceleration of the deflagration rate; and the effects of irradiation-induced deflagration rate modification in all solids systems, as opposed to the solid gas system of the burners. S.C.W.

N65-25455# Library of Congress, Washington, D. C. Aerospace Technology Div.
INVESTIGATION OF THE SURFACE STRUCTURE OF BURNING MODEL MIXTURES OF SOLID FUELS [ISSLEDOVANIYE STRUKTURY POVERKHNOSTI GORENIYA MODEL' NYKH SMESEVYKH TVERDYKH TOPLIV]
P. F. Pokhil and L. D. Romodanova 17 May 1965 10 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 39, no. 2, 1965 p 294–299
(ATD-T-65-28; AD-463137) CFSTI: HC $1.00/MF $0.50

To understand the burning mechanism of composite solid propellants, the structure formed during the burning of stoichiometric model mixtures was investigated. The following oxidants were used in the mixtures: ammonium perchlorate, which does not melt, but is self-inflammable at 360° to 380° C; potassium perchlorate, which melts with decomposition at 610° C; and sodium perchlorate, which melts at 482° C and decomposes at 505° C. The following fuels having different physicochemical properties were selected for the investigation: graphite, which does not melt and does not decompose; tungsten, which melts at about 3200° C; naphthalene, which melts and sublimes at 80° C; starch, which melts and decomposes at 260° C; succinic acid, which melts at 185° and decomposes at 235° C; and malonic acid, which melts at 135.6° C. Among the conclusions drawn from this investigation was that in the pressure region of less than 30-atm absolute, oxidant crystals appear on the surface of burning mixtures containing the nonmelting oxidant ammonium perchlorate and of fuels melting or decomposing at temperatures close to the oxidant decomposition temperature. E.E.B.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N65-24780# California Inst. of Tech., Pasadena. Firestone Flight Sciences Lab.
SOLID ROCKET STRUCTURAL INTEGRITY ABSTRACTS, VOLUME I, NO. 2
A. R. Zak Oct. 1964 126 p refs
(Contract AF 04(611)-9572)
(AD-612260)

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1. THE APPLICATION OF NUMERICAL METHODS TO THE SOLUTION OF STRUCTURAL INTEGRITY PROBLEMS OF SOLID PROPELLANT ROCKETS C. H. Parr p 2–56 refs (See N65-24781 14-28)
2. MECHANICAL CHARACTERIZATION p 58–69 refs
3. THERMAL CHARACTERIZATION p 70–73 refs
4. OPTICAL CHARACTERIZATION p 74–77 refs
5. ANALYTICAL METHODS p 78–98 refs
6. FAILURE p 99–102 refs
7. SPECIAL TEST PROCEDURES p 103–113 refs
8. PHYSICO-CHEMICAL EFFECTS ON MECHANICAL BEHAVIOR p 114 refs

N65-24781 California Inst. of Tech., Pasadena.
THE APPLICATION OF NUMERICAL METHODS TO THE SOLUTION OF STRUCTURAL INTEGRITY PROBLEMS OF SOLID PROPELLANT ROCKETS
Charles H. Parr (Rohm and Haas Co.) *In its* Solid Rocket Structural Integrity Abstr., V. I, No. 2, Oct. 1964 p 2–56 refs (See N65-24780 14-28)

The application of numerical methods by high speed digital computation to the problems of stress analysis of solid propellant grains is reviewed briefly. Only static and quasi-static problems were considered. Discussed are the following models: (1) one-dimensional problems; (2) two-dimensional problems—for linear elastic materials, linear viscoelastic materials, nonlinear materials, and granular materials; and (3) three-dimensional problems. Also listed are all computer programs currently in use for structural analysis of solid propellants at the major propellant and airframe companies. G.G.

N65-24789# Thiokol Chemical Corp., Brigham City, Utah. Wasatch Div.
WEAPON SYSTEM 133A: EXTENDED R & D EFFORT STAGE I MINUTEMAN MOTORS Program Progress Report, 1 Oct.–31 Dec. 1964
U. E. Garrison [1964] 42 p
(Contract AF 33(600)-36514)
(AD-461545)

The objective of the program was to assure that the Stage I Minuteman motor is capable of withstanding the operational environmental conditions encountered during air, highway, and rail transportation and handling as a motor or when assembled into an entire missile. Analytical and experimental methods used to demonstrate, verify, and predict the capability of the Stage I motor included mathematical analyses, laboratory testing, full-scale vibration testing, broad-course testing, and actual motor and missile transportation by air, highway, and rail. The Stage I Minuteman motor was found to be capable and suitable for hardened and dispersed operational use and can withstand all normal transportation and handling environments without compromise of reliability or performance. A large safety margin exists between the actual operational transportation dynamic environment and the demonstrated and predicted ability to withstand such an environment. R.W.H.

N65-24831# Thiokol Chemical Corp., Huntsville, Ala. Engineering Dept.
EVALUATION OF THREE ARDE-PORTLAND CRYOGENIC STRETCHED FORMED SUBSCALE ROCKET MOTOR CASES Phase Report

David L. Daigle 23 Apr. 1965 228 p
(Contract DA-01-021-ORD-11919)
(Rept.-21-65; AD-462137)

Three motor cases, 12.5 inches in diameter, were evaluated. They were made from AISI 301 stainless steel by a cryogenic stretch forming process. After dimensional and radiographic inspections, each case was subjected to a hydrostatic burst pressurization test at −65° F. Performance of the cases under the low temperature pressurization tests was satisfactory. Each case failed in a ductile manner at biaxial strength levels of 310 500 psi (case no. 1), 300 100 psi (case no. 2), and 342 800 psi (case no. 5). Maximum recorded elongation in each case was approximately 2%. Performance of the three cases under pressurization at low temperature demonstrated that the cryogenic stretch forming process is a potential fabrication technique for the manufacture of motor cases for future missile systems.

N65-24869# Argonne National Lab., Ill.
ELECTRICAL END LOSSES IN AN MHD CHANNEL OF LINEARLY VARIABLE CROSS SECTION
Jerzy R. Moszynski Mar. 1965 26 p refs
(Contract W-31-109-ENG-38)
(ANL-6963) CFSTI: $1.00

The electrical losses due to end-shorting of electrodes in an MHD channel of linearly variable cross section have been calculated, under the assumption of large Reynolds number and small magnetic Reynolds number. It is shown that a simplified calculation procedure yields exact results and, further, that an approximate procedure, based on the results for a constant-area channel, provides satisfactory accuracy for channels of small included angle and/or relatively large aspect ratio. Author

N65-24927# Massachusetts Inst. of Tech., Cambridge.
AIRCRAFT PROPULSION. A REVIEW OF THE EVOLUTION OF AIRCRAFT POWERPLANTS
C. Fayette Taylor *In* Smithsonian Inst. Ann. Rept. of the Smithsonian Inst., 1962 [1962] p 245–298 (See N65-24925 14-34) GPO $4.75

Aircraft powerplants are reviewed historically, from early attempts to fly using human muscles, through steam and internal combustion engines, then to today's turbine, jet, and rocket engines. Facsimilies of early correspondence and newspaper articles and illustrations of representative engines accompany the text. Charts of the piston-engine family tree, characteristics of selected water- and air-cooled engines, and contributions by various nations to aircraft propulsion are also given. M.P.G.

N65-24928# Low Alamos Scientific Lab., N. Mex.
ROCKET PROPULSION
Ralph S. Cooper *In* Smithsonian Inst. Ann. Rept. of the Smithsonian Inst., 1962 [1962] p 299–313 (See N65-24925 14-34) GPO: $4.75

Propulsion is discussed as the crucial problem of space exploration. Velocity requirements for lunar, planetary, and interplanetary missions and the associated weight considerations are presented, and rocket principles are reviewed. Chemical propulsion systems, including liquid and solid propellants and methods proposed for improving their performance, are discussed. Nuclear and other advanced propulsion systems are considered, and comparisons are made of performance of the various propulsion systems for different missions. A brief discussion of auxiliary power systems is included. M.P.G.

N65-25262# Catholic Univ. of America, Washington, D. C. Stress Analysis Lab.
EXPERIMENTAL STRAIN AND STRESS ANALYSIS OF SOLID PROPELLANT ROCKET MOTORS Interim Report
A. J. Durelli Mar. 1965 116 p refs
(Contract Nonr-2249(06))
(IR-6; AD-615038)

A review is made of the methods used to strain-analyze solid propellant rocket motor shells and grains when subjected to different loading conditions. The review includes methods directed at the determination of strains in actual rockets, and also at the determination of strains in rocket models. The surveyed methods include two- and three-dimensional photoelasticity, brittle coatings, electrical strain-gages, moiré, and grids. Author

N65-25276*# Astro Met Associates, Inc., Cincinnati, Ohio.
DEVELOPMENT OF LARGE SIZE FINISHED POROUS TUNGSTEN IONIZERS Final Report
John W. Graham and Raj K. Malik 18 Mar. 1965 110 p refs
(Contract NAS3-4115)
(NASA-CR-54189; ASTRO MET-9-1-0032) CFSTI: HC $4.00/MF $0.75

Several large-size porous tungsten emitter plates almost 4 in. in area were prepared for evaluation as a result of extensive powder metallurgy and chemical processes. The tungsten structural characteristics met, and in some cases exceeded, the specifications. The structures exhibited mean pore diameters from 1.1μ to 1.7μ in discrete levels with very narrow desirable ranges, open pore volume between 19% and 24%, pore count between 0.9 to 4 × 10^7 pores/cm^2, and transmission coefficient between 11 and 22 × 10^{-5}, plus thermal stability to at least 2750° F. The process consists of milling uniformly ultrafine tungsten, copper and nickel powders, hydrostatically pressing, liquid phase sintering at 2150° to 2250° F for periods from 5 to 25 hours, hydrochloric and then nitric acid leaching to efficiently remove the copper and nickel phase, reducing in wet hydrogen at 1800° F, and vacuum bleaching at 2750° F. The process allows close control of grain size, pore diameter, and pore volume. In addition, it results in almost spherical tungsten grains, and is believed to be easily reproducible. Author

N65-25349*# Space Dynamics Corp., Cincinnati, Ohio. Plasmajet Systems Div.
DOUBLE DISCHARGE FEASIBILITY Summary Report
M. L. Ghai and N. A. Pena 31 May 1965 110 p refs
(Contract NAS8-2557)
(NASA-CR-542-46; SDC-PJ-03) CFSTI: HC $4.00/MF $0.75

Feasibility of a double discharge rocket engine was evaluated experimentally. In this rocket design the propellant is accelerated by two independently controlled electrical discharges within the same channel, where the first discharge is high pressure subsonic and the second is low pressure supersonic. In the experimental unit the rocket nozzle was segmented to permit study of heat flux and the striking points of the electrical arcs. Design objective was to achieve flexible performance in a wide range of 1500 to 5000 seconds. The possible consequences of having two unlike discharges in close proximity were of primary interest. The tests showed that the supersonic discharge was very stable, even more then the subsonic discharge. The supersonic discharge was well distributed over the electrode surface. Very high enthalpy levels were noted in some test firings. The current and power levels in the two discharges could be varied. The test unit could be operated with either discharge alone, as well as with both. Feasibility of the double discharge engine was considered established. J.M.D.

N65-25373*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
NAVIGATOR STUDY OF ELECTRIC PROPULSION FOR UNMANNED SCIENTIFIC MISSIONS. VOLUME I: MISSION ANALYSIS
H. Brown and J. Taylor 1 Mar. 1965 130 p refs
(Contract NAS3-2533)
(NASA-CR-54324; Doc.-65SD4296, Vol. I)

The analytical techniques applied in the mission analyses are described. The vehicle and powerplant requirements are presented in terms of trip time, power level, and payload for optimum orbiter and flyby missions as accomplished by electrically propelled spacecraft. Also, the payload and trip time capabilities for chemical, and chemical plus nuclear propelled spacecraft for the same missions are included. E.E.B.

N65-25376# Curtiss-Wright Corp., Wood-Ridge, N. J. Wright Aeronautical Div.
HIGH TEMPERATURE TURBINE COMPONENT DEVELOPMENT FOR TRECOM SMALL GAS TURBINE ENGINE PROGRAM Monthly Technical Report No. 11
15 May 1965 32 p
(Contract DA-44-177-AMC-182(T))
(WAD-R-419-11)

Work continued toward the design finalization of the stator blade, the rotor blade, and the turbine rotor blade–disc assembly. Welding was initiated to evaluate and develop the cast blade–cast disc welded joint design for the initial turbine rotor material combination. The first set of stator blades was retested and an improved temperature profile at the combustion chamber exit was established. A second set of stator blades with improved shelf surfaces was tested for a total of 7 hrs 45 min, accumulating an additional 8 hrs 55 min, on the combustion chamber. Temperature profiles and typical blade test data, as well as the time and temperatures accumulated on the blades tested, are presented in tables. Results show that two blades operated at peak gas temperatures of 2420° and 2550° F for 4 hrs 15 min, remained in excellent condition. A brief resume of the testing accomplishments is included. G.G.

N65-25549*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY OPERATION OF OXIDE-COATED BRUSH CATHODES IN ELECTRON-BOMBARDMENT ION THRUSTORS
William R. Kerslake Washington, NASA, Jun. 1965 13 p refs
(NASA-TM-X-1105) CFSTI: HC $1.00/MF $0.50

Initial experimental results with thick-oxide-coated wire brush cathodes have yielded thrustor operating lifetimes in excess of 1000 hours. A 0.5-cm-diam cathode operated in a 5-cm thrustor for 1553 hours, and a 1-cm-diam cathode operated for 3903 hours in a 7.5-cm-diam thrustor simulator. Another nominal 1-cm-diam cathode operated 1250 hours in a 20-cm-diam thrustor. The radial wires in the brush design provided thermal and electrical conduction paths and reduced arc damage significantly. Each brush cathode at failure contained one-third or more of the original quantity of oxide. Greater cathode lifetimes should be attainable when present failure mechanisms are fully understood and corrective measures are applied.
Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N65-24458# Buenos Aires Univ. (Argentina). Dept. of Exact and Natural Sciences
HIGH ENERGY SOLAR PARTICLE EVENTS
Juan G. Roederer Buenos Aires, Argentine Natl. Comm. on Space Res., 1964 44 p refs Presented at Symp. on IGY Results, U.S. Natl. Acad. of Sci., Los Angeles, Aug. 1963
(CNIE-PT-3e)

High energy solar particles are discussed, beginning with their origin from a great solar outburst, and including the processes occurring when they travel through the earth's magnetosphere. The problem of how to connect the unknown particle flux, energy spectrum and angular distribution in space to measurements made on earth's surface is discussed, followed by experimental information on interplanetary space propagation, scattering, and trapping properties of high energy particles. Finally, comments are made on the flare acceleration mechanism. R.C.S.

N65-24475# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COSMIC RESEARCH
6 Feb. 1964 245 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 1, no. 2, Sep.–Oct. 1963 p 195–334
(FTD-TT-64-42/1+2+4; AD-429870)

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11. EFFECT OF HIGH-ENERGY PROTONS ON SILICON PHOTOCELLS B. M. Golovin, G. M. Grigor'yeva, A. P. Landsman, and B. P. Osipenko p 135–161 refs (See N64-23040 16-06)

12. A SERIES OF MINIATURE MASS SPECTROMETERS FOR INVESTIGATING THE COMPOSITION OF NEUTRAL AND IONIZED GASES IN THE UPPER LAYERS OF THE ATMOSPHERE V. A. Pavlenko, A. E. Rafal'son, and M. D. Shutov p 162–174 refs (See N65-24486 14-14)

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14. ENSURING RADIATION SAFETY DURING FLIGHTS OF VOSTOK-3 AND VOSTOK-4 V. V. Antipov, Yu. I. Efremov, M. D. Nikitin, I. A. Savenko, and P. P. Saksonov p 186–195 refs (See N65-24487 14-29)

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16. EFFECT OF SPACE FLIGHT FACTORS ON THE VOSTOK-3 AND VOSTOK-4 ON THE MICROSPORES OF TRADESCANTIA PALUDOSA N. L. Delone, P. R. Popovich, V. V. Antipov, and V. G. Vysotskiy p 200–224 refs (See N65-24489 14-04)

N65-24477 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE RADIATION OF THE SOLAR CORONA IN THE SOFT X-RAY REGION

Ye. P. Fetisov *In its* Cosmic Res. 6 Feb. 1964 p 30–43 refs (See N65-24475 14-29)

A determination of the radiation flux of the solar corona in the spectrum range smaller than 10 A is given. Ion concentrations of the most widespread elements are calculated in the temperature range from $1 \cdot 10^{6\circ}$ to $4.5 \cdot 10^{6\circ}$ K. Radiation fluxes during free–free and free–bound transitions are obtained, as well as radiation in lines. At temperatures from 1 to 3 million degrees the main contribution to the radiation results from recombination of the ions of heavy elements. The calculations are performed on an electronic computer. Author

N65-24481 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF THE THERMAL RADIATION FIELD OF THE STRATOSPHERE AND TROPOSPHERE IN THE INFRARED REGION OF THE SPECTRUM USING GEOPHYSICAL BALLOONS

M. N. Markov, Ya. I. Marson, and M. P. Shamilev *In its* Cosmic Res. 6 Feb. 1964 p 74–96 refs (See N65-24475 14-29)

Experimental data are given on the shape of the curve of the angular distribution of this radiation, on the degree of isotropy, and on the meteorological heterogeneities based on measured thermal radiation in the wide infrared region of the spectrum. Disagreement is pointed out between the experimental data on the shape of the angular distribution and theoretical calculations. Author

N65-24483 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ARGON IONIZATION IN THE UPPER ATMOSPHERE

A. D. Danilov *In its* Cosmic Res. 6 Feb. 1964 p 108–115 refs (See N65-24475 14-29)

Problems of the formation and disappearance of argon ions in the atmosphere are considered. It is shown that radiative recombination alone cannot cause disappearance of these ions. Lower boundary of the constant of ion exchange reactions which should be responsible for the disappearance of the A^+ ions is estimated. A distribution of these ions with height is obtained. Author

N65-24485 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MASS-SPECTROMETRIC MEASUREMENTS OF He^+, N^+, O^+, NO^+, AND O_2^+ ION DISTRIBUTION IN THE EARTH'S ATMOSPHERE UP TO 430 km

A. A. Pokhunkov *In its* Cosmic Res. 6 Feb. 1964 p 128–134 refs (See N65-24475 14-29)

This article gives distribution of absolute concentrations of ions in the height range 130 to 430 km obtained by means of a radiofrequency mass spectrometer on a geophysical rocket. Presence of helium ions was detected at heights above 370 km. Author

N65-24487 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ENSURING RADIATION SAFETY DURING FLIGHTS OF VOSTOK-3 AND VOSTOK-4

V. V. Antipov, Yu. I. Efremov, M. D. Nikitin, I. A. Savenko, and P. P. Saksonov *In its* Cosmic Res. 6 Feb. 1964 p 186–195 refs (See N65-24475 14-29)

Data are cited on the radiation situation in outer space before and during the twin flight of Vostok-3 and Vostok-4. A brief description of cosmic radiation is given. The basic measures for ensuring radiation safety of the twin space flight are discussed. Author

N65-24527 Joint Publications Research Service, Washington, D. C.

ON THE LOW-FREQUENCY SPECTRUM OF COSMIC RADIO-EMISSION

S. Ya. Braude and V. V. Vaysberg *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 17–29 refs (See N65-24525 14-07) CFSTI: $7.00

The low-frequency (<10 Mc) spectrum of cosmic radio emission is considered to be the consequence of absorption of synchrotron halo radiation by the ionized hydrogen of the galactic disk. As a result of nonuniform distribution of H-II in the disk, one may expect that the measure of emission (which characterizes the degree of absorption) in the given direction differs from the measure of emission in other directions (within the limits of the directivity diagrams of the radiation detector) according to a random law. Judging by the parameters of emission distribution calculated on the basis of experimental results, the intensities of cosmic radiation at frequencies below 10 Mc (measured by antennas of various directivities) may differ considerably. The fluctuations arising in connection with this must depend on the frequency and should reach 37% of the halo radiation intensity. Author

N65-24660*# National Aeronautics and Space Administration, Washington, D. C.

MULTIPLE FORMATION OF NUCLEON PAIRS AND OUTBURSTS OF SUPERNOVAE [MNOZHESTVENNOYE OBRAZOVANIYE NUKLONNYKH PAR I VSPYSHKI SVERKHNOVYKH]

D. A. Frank-Kamenetskiy Apr. 1962 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Fiz. (Moscow), v. 143, no. 1, Mar.–Apr. 1962 p 78–80
(NASA-TT-F-8215) CFSTI: HC $1.00/MF $0.50

Results of this investigation on multiple formation of nucleon pairs and outbursts of supernovae indicate that: (1) π° mesons are a source of multiple formation of nucleon pairs and this formation is facilitated by the presence of gravitational fields. (2) Matter, consisting of nucleon pairs and stabilized by the gravitational field and high temperature, really is a

variety of charged particle plasma referred to as epiplasm. (3) Residues of supernova explosions must be epiplasm-containing stars. Their interstellar gas must lead to a gradual substitution of antimatter by matter, with the ensuing annihilation of the antimatter liberated in the outer layers of the stars. The diffusive character of the exchange process of antimatter into matter leads to the formation of a comparatively cold envelope around the dense epiplasmic nucleus; thus, the residues of outbursts of type I supernovae must consist of nonstationary flashing stars of the UV-Cetus type, and those of type II supernovae–stars of type T-Taurus. I.v.L.

N65-24661*# National Aeronautics and Space Administration, Washington, D. C.

ON A POSSIBLE MECHANISM OF PARTICLE EJECTION FROM THE SUN [OB ODNOM VOZMOZHNOM MEKHANIZME VYBROSOV NA SOLNTSE]

V. S. Komel'kov Oct. 1962 11 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 146, no. 1, Sep.–Oct. 1962 p 58–61

(NASA-TT-F-8305) CFSTI: HC $1.00/MF $0.50

The bipolar structure of the magnetic hydrodynamic vortexes generated in the sun is discussed, with emphasis on vortexes essentially unequilibrated and distorted with a diameter of $D/2d \approx 1$. Experimental investigation of the latter and of plasma jets generated by them established the following qualities: (1) The vortex structure does not vary with the type of gas at great energies. (2) Current in the discharge did not affect the structure in the 10^{-3}mm. Hg + 1 atmosphere range. (3) A field H_z is found inside the plasma coaxial formed by the twisting of the longitudinal current into a spiral. (4) Jet extension resulted in plasmoid separation and introduction of independent m.h.v. of the same structure and propagation cycle. (5) The jet's longitudinal velocities exceed several times the transverse velocities. (6) The plasma coaxial and the current filament emit a continuous spectrum. (7) The X-ray emission of 200 to 250 keV from the current filament is observed at a 10- to 20-kV potential difference on the jet bypass. (8) Jets easily penetrate the magnetic fields. (9) The jet structure is steady relative to the geometrical vortex. G.G.

N65-24662*# National Aeronautics and Space Administration, Washington, D. C.

POSSIBILITY OF MEASURING ELECTRON CONCENTRATIONS IN THE UPPER IONOSPHERE AND IN INTERPLANETARY SPACE BY PLASMA WAVE RADIATION [O VOZMOZHNOSTI IZMERENIY ELEKTRONNOY KONTSENTRATSII V VERKHNEY IONOSFERE I MEZHPLANETNOM PROSTRANSTVE PO IZLUCHENIYU PLAZMENNYKH VOLN]

N. A. Mityakov and V. O. Rapoport Oct. 1962 10 p refs Transl. into ENGLISH from Iz. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 5, no. 3, 1962 p 464–467

(NASA-TT-F-8306) CFSTI: HC $1.00/MF $0.50

Determination of the dependence of radiation impedance on frequency makes it possible to evaluate plasma frequency and thereby plasma electron concentration, since the errors attributable to the presence of a constant magnetic field are small and can be accounted for when the magnetic field intensity is known. The expression for radiation impedance of an elementary dipole is derived for the case of low anisotropy, when a relatively narrow frequency range near the plasma frequency (the plasma wave's refraction index) is > 1. On the basis of this expression, the elementary dipole radiation impedance for the upper part of the F-layer ($n = 3.5 \cdot 10^5$ electrons/cm^3, T 10^3 °K) was calculated to be of the order of $5 \cdot 10^4$ ohm with a dipole length of 5 cm. A similar calculation for interplanetary space gas ($n = 10^2$ electrons/cm$_3$ $T = 10^4$ °K) gives the same resistance value for a dipole length of 10^3 cm. Author

N65-24665*# National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF X-RADIATION ORIGINATING IN A FLARE ON THE D-REGION OF THE IONOSPHERE [VOZDEYSTVIYE RENTGENOVSKOGO IZLUCHENIYA VSPYSHKI NA OBLAST' D IONOSFERY]

Yu. I. Neshpor Oct. 1962 14 p refs Transl. into ENGLISH from Ionosphere Res., Sec. V, IGY Program (Moscow), no. 10, 1962 p 27–33

(NASA-TT-F-8302) CFSTI: HC $1.00/MF $0.50

The distorted course of electron density in the F-region of the ionosphere, caused by X-radiation in the 1-10 Å wave band is discussed. It is found that the distribution curve of excess ionization has a monotonic character. For all examined forms of the energy distribution function the most significant distortions of the electron density curve take place at the 80-km altitude level and below. It is doubtful that any other form of the curve of electron density distribution would be possible in time of sudden ionospheric disturbances. Author

N65-24670*# National Aeronautics and Space Administration, Washington, D. C.

ON THE INFLUENCE OF THE SUPERCORONA ON RADIO EMISSION FROM THE SUN [O VLIYANII SVERKHKORONY NA PRINIMAYEMOYE RADIOZLUCHENIYE SOLNTSA]

V. V. Vitkevich and N. A. Lotova 8 Jan. 1962 15 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 4, no. 3, 1961 p 415–424

(NASA-TT-F-8133) CFSTI: HC $1.00/MF $0.50

Calculations are made of the influence of the supercorona on radio emission from separate regions of the sun for a radial model of inhomogeneities. Finite distances between the source of radio emission and the scattering regions of the supercorona are considered. Scattering angles are calculated for functions of the types $\Psi(x) = \Psi_0 x^{-n}$ and $\Psi^2(x) = \Psi_1^2 x^{-n_1} + \Psi_2^2 x^{-n_2}$. Expressions are obtained for the coefficients of scattering attenuation due to finite distances from the source to the scattering regions. Finite distances from the source of radio emission to the scattering regions of the supercorona also lead to a decrease by 3 to 10^2 of the scattering effect for various positions of the sources. Apparent angle dimensions of active regions of the sun for 3.5-, 5.8- and 12-m waves are compiled. Observation of these regions makes it possible to obtain new data on the structure of electron inhomogeneities in the supercorona. Author

N65-24694# Joint Publications Research Service, Washington, D. C.

COSMIC RAY VARIATIONS

L. Dorman 31 May 1965 14 p refs Transl. into ENGLISH from Nauka i. Zhizn' (Moscow), no. 2, Feb. 1965 p 80–85

(JPRS-30352; TT-65-311-33) CFSTI: $1.00

The observed variations of cosmic-ray intensity are divided into three classes on the basis of their nature, and each class is discussed. Variations caused by changes in the earth's atmosphere over the observation station give information on the meteorological conditions in the upper layers of the atmosphere. Variations caused by changes in the earth's magnetic field are due to deflection from the initial direction of movement, and in periods of solar flare activity, to the formation of

a ring current which decreases the shielding effect of the geomagnetic field. Special formulas and characteristics of secondary particle fluxes are used to compute the energy and direction of movement of primary cosmic rays responsible for the extraterrestrial variations. Methods of distinguishing solar, galactic, and metagalactic cosmic rays are discussed.
R.C.S.

N65-24701# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
INTERACTION OF HYDROMAGNETIC SHOCKS WITH CHARGED PARTICLES IN THE SOLAR CORONA
James B. Weddell Aug. 1964 94 p refs
(SID-64-1500; AD-459191)

Electromagnetic radiation emitted by solar flares heats the corona and causes its sudden expansion accompanied by hydromagnetic shock. As the magnetic field disturbance carried by the shock overtakes charged particles composing the solar wind, they are accelerated. Acceleration of a given particle ceases usually when this particle is scattered by another and emerges from either surface of the shock. As the shock advances it is attenuated by energy transfer to the accelerated particles, and its velocity decreases to that of the solar wind. Motion of protons subject to magnetic fields associated with hydromagnetic shocks was analyzed. Energy distribution of mutually scattered protons was evaluated for rare and dense regions of the corona. Energy distribution of protons in space near earth, resulting from hydromagnetic acceleration and scattering throughout the corona, was calculated as a function of time and direction of arrival of the protons. Resulting spectrum resembles spectra in solar proton events. Author

N65-24711# Lockheed Missiles and Space Co., Sunnyvale, Calif. Research Labs.
TABLES OF NEUTRAL ATMOSPHERIC PROPERTIES AS A FUNCTION OF SOLAR ACTIVITY AND LOCAL TIME FROM 90 TO 10000 KM
A. D. Anderson and W. E. Francis Mar. 1965 73 p refs
(LMSC-6-75-65-19)

A semitheoretical model of the upper atmoshpere was constructed to allow calculation of the primary neutral atmospheric properties from 90 to 10000 km as a function of local time and solar activity. Results of these calculations are presented in tables for various local times and solar activities over a solar cycle. Density in the exosphere is corrected for the escape of atomic hydrogen from the earth's atmosphere. To check the model, the temperature, molecular weight, density and number densities for O, O_2, and N_2 are computed from 130 to 200 km for conditions of solar activity and local time corresponding to measurements actually made. Observed properties and those calculated with the model differ by an average of 10%. Author

N65-24744# Joint Publications Research Service, Washington, D. C.
COSMIC RADIATION STUDIES
27 May 1965 91 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 3, no. 2, Mar.–Apr. 1965 p 237–296
(JPRS-30286; TT-65-31099) CFSTI: $3.00

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N65-24745 Joint Publications Research Service, Washington, D. C.
INVESTIGATIONS OF DIFFUSE ULTRAVIOLET RADIATION IN THE EARTH'S UPPER ATMOSPHERE
S. I. Babichenko, I. P. Karpinskiy, S. A. Kaplan, V. V. Katyushina, L. N. Krylov et al *In its* Cosmic Radiation Studies 27 May 1965 p 1–37 refs (See N65-24744 14-29) CFSTI: $3.00

Apparatus for the registration of diffuse ultraviolet radiation in the earth's upper atmosphere is described. It consists of two Geiger photon counters with NO-filling and windows of lithium fluoride, sensitive in the 1050–1340 Å band; a supplementary filter of calcium fluoride (CaF_2) was placed in front of one of the counters. The pulses taken from the anodes of the counters were registered with a two-channel logarithmic intensimeter in the interval of the counting rates from 2 to 2×10^3 pulses/second. The circuit was constructed on the modular principle and consisted of a preamplifier, trigger, pulse normalizer, storage element, dc amplifier, line voltage regulator, and a high-voltage transformer for the power supply of the photon counters. Author

N65-24746 Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF SOLAR X-RADIATION. IV. RADIATION FLUX MEASUREMENTS IN THE 2–18 A REGION OF THE SPECTRUM
I. P. Tindo and A. Y. Shurygin *In its* Cosmic Radiation Studies 27 May 1965 p 38–45 refs (See N65-24744 14-29) CFSTI: $3.00

The results are presented of measurements of the flux of solar X-radiation in the 2–18 Å region of the spectrum, made in vertical launchings of geophysical rockets to a height of about 500 km. The color temperature of the radiation in that region of the spectrum was determined; the results of the measurements are compared with the calculated values. Author

N65-24748 Joint Publications Research Service, Washington, D. C.
INVESTIGATIONS OF ATMOSPHERIC BRIGHTNESS AT ALTITUDES OF 120–450 KILOMETERS
A. Ye. Mikirov *In its* Cosmic Radiation Studies 27 May 1965 p 69–88 refs (See N65-24744 14-29) CFSTI: $3.00

The article gives the results of measurement of the energetic brightness of the sky in the daytime in the 3200 to 3800 Å region of the spectrum, made during the launchings of geophysical rockets. Data show that, starting at a height of 120 km, the brightness of the atmosphere illuminated by the sun decreases monotonically and at a height of about 450 km is 1.5×10^{-10} watts/(cm^2) (ster) (μ). A comparison of the measured brightnesses with those calculated for an absolutely pure atmosphere shows the presence of a large excess of energetic brightness of the daytime sky. On the

assumption that the excess airglow is caused by aerosol scattering of light, an estimate is made of the aerosol scattering coefficient and the density of the scattered substance. Author

N65-24910 National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board
SOLAR PHYSICS
In its U.S. Space Sci. Program, Rept. to COSPAR 1963 p 10–16 (See N65-24908 14-30)

The NASA Orbiting Solar Observatory, OSO I, which was launched in March 1962 into orbit around the sun is described in detail, and its transmitted data on the solar ultraviolet spectrum and on solar X-ray flux are discussed. Studies of Type II and Type III solar radio bursts and solar radar, prediction of solar flares with experimental errors reduced to 30%, investigation of various aspects of the solar corona by rocket and by the ground-based High Altitude Observatory, and the solar spectrometer to be flown on the OSO II, are described. J.M.D.

N65-24911 National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board
ENERGETIC PARTICLES AND FIELDS
In its U.S. Space Sci. Program, Rept. to COSPAR 1963 p 17–35 (See N65-24908 14-30)

Studies of energetic particles and fields in space are reported. Emphasized are particles of magnetospheric and solar origin, and the injection and loss of trapped particles. Some practical considerations are the safety of astronauts making flights into space, and the effects of high-altitude nuclear tests. Author

N65-25004*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy
DIURNAL AND LATITUDE EFFECTS OBSERVED FOR 10 keV ELECTRONS AT LOW SATELLITE ALTITUDES
Theodore A. Fritz and Donald A. Gurnett Feb. 1965 60 p refs *Its* Rept.-65-3
(Grant NsG-233-62; Contract Nonr-1509(06))
(NASA-CR-62888) CFSTI: HC $3.00/MF $0.50

Using a low energy electron detector on the low altitude, high latitude satellite Injun III, large diurnal and latitude effects were observed for 10 keV electrons. It is found that intense fluxes of low energy electrons, $j\ (E_e \geq 10\ \text{keV}) \geq 2.5 \times 10^7$ electrons $(\text{cm}^2\ \text{ster}\ \text{sec})^{-1}$, occur only during local night between 1700 hours and 0700 hours (magnetic local time) and that they occur only between 58° and 76° invariant latitude. These intense fluxes of low energy electrons occur predominantly during periods of high geomagnetic activity. It is also found that a large change in the slope of the electron energy spectrum is associated with the trapping boundary for 40 keV electrons found at high latitudes during local night. This change is from a relatively hard spectrum inside the boundary to a very soft spectrum just outside the boundary. The intense fluxes of very soft electrons found beyond the 40 keV trapping boundary at low altitudes are thought to be related to the intense fluxes of low energy electrons found by Gringauz, and by Freeman at great distances on the night side of the earth. Author

N65-25298# Royal Aircraft Establishment, Farnborough (England).
SATELLITES AND CHARGED CORPUSCULAR RADIATION
M. J. Downey [1964] 47 p refs Presented at the European Space Res. Organ. Summer School, Oxford, 10 Aug.–3 Sep. 1964

The magnitude of the task and the background facilities required to answer the apparently simple question "What is the lifetime of a satellite in a given orbit, from the point of view of radiation?" is enormous. An attempt is made in this note to outline the approach and type of studies which must be undertaken when considering this encounter between satellites and the trapped charged corpuscular radiation in space. As a first approach to the subject, a brief summary of measurements from chosen satellites is given, leading to a current approximate physical picture of trapped radiation in the earth's magnetic field. This is followed by some theoretical aspects including radiation origins and the recently adopted B,L coordinate system for the mapping of particle intensities. In the next section, the interaction of radiation with matter is considered as a result of which various methods of calculating the absorbed radiation dose in a satellite is described. Finally, the effects of radiation on various possible satellite components, such as semiconductors, plastics, rubbers, etc., is outlined, along with some of the damaging mechanisms involved. Author

N65-25378# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy
SOLAR X-RAY OBSERVATIONS BY INJUN I
B. Maehlum, L. A. Frank, and J. A. Van Allen Jul. 1964 29 p refs
(Contract (Nonr-93803)
(SUI-64-27; AD-603427)

On the basis of 36 random observations of the sun during July–August 1961 with a thin mica window Geiger tube on satellite Injun I, it is found that: (1) The quiet-day solar X-ray flux at AU in the wave length range $\lambda < 14$ Å is about 1×10^{-3} ergs $(\text{cm}^2\ \text{sec})^{-1}$, a value which is approximately independent of the assumed blackbody temperature of the emitting areas of the sun over the temperature range 0.8 to 8×10^6° K. (2) There is clear enhancement of such X-ray flux during visual solar flares—by a factor of about 4 during 1 or 1^+ flares and by a factor of about 40 during a 3^+ flare. The highest flux in the region $\lambda < 14$ Å is 0.04 ergs $(\text{cm}^2\ \text{sec})^{-1}$ during a 3^+ flare on July 20, 1961. The corresponding total flux for an assumed blackbody temperature of 2×10^6° K is 0.2 ergs $(\text{cm}^2\ \text{sec})^{-1}$. The time required for the solar X-ray emission to return to quiescent values after a flare of importance 1 is 1 to 2 hours. For more important flares the time is greater. Author

N65-25400*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
CORPUSCULAR STREAMS RELATED TO SOLAR M-REGIONS
Tatsuzo Obayashi 24 Aug. 1964 30 p refs Presented at Inter-Union Comm. on Solar Terrest. Relations, Hamburg, 24 Aug. 1964
(NASA-TM-X-56520) CFSTI: HC $2.00/MF $0.50

Recent studies on 27-day recurrence geomagnetic disturbances and their associated phenomena during the decline phase of the present sunspot cycle are summarized. An identification of M-region with solar phenomena was made by evaluating the velocity of solar winds. Discussions are given on various existing hypotheses of corpuscular streams producing M-disturbances. Author

N65-25450# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
HIGH ALTITUDE COSMIC RAY INTENSITY MEASUREMENTS AT LOW GEOMAGNETIC LATITUDES. PART I: LOW WEIGHT EQUIPMENT FOR COSMIC RAY DETECTION

H. S. Ghielmetti, A. M. Godel, and J. G. Roederer (Buenos Aires Univ.) 1964 16 p refs
(CNIE-PT-IE)

The technique of constant level flights with small extensible balloons was used. A reliable valve-controlled system to level neoprene balloons with payloads of several kilograms at atmospheric depths below between 4 and 10 g/cm^2 was developed. Two types of simple and low weight detector systems for measurement of the total ionizing component are described: (1) a single G-M counter unit, telemetering counting rate and atmospheric pressure, with total weight (including gondola and parachute) 1200 grams; a double G-M counter telescope unit, with telemetry of the two single counter rates, coincidence rate and atmospheric pressure, with total weight 2000 grams. With the light payloads used, leveling depths down to 4 g/cm^2 were reached. Duration of the measurements was limited by the transmitter range: 8-hour flights were achieved at low wind conditions. In 24 flights, the payload was recovered in 12 opportunities. Constant level flights with extensible balloons carrying the low weight equipment described, proved particularly suitable for a low cost program of high-altitude cosmic ray intensity monitoring. Author

N65-25531# American Meteorological Society, Boston, Mass.
USE OF RADIO DATA TO DETERMINE THE POSITION OF THE REGION IN WHICH THE CHARACTERISTICS OF THE SOLAR ATMOSPHERE CHANGE RAPIDLY [OPREDELENIE POLOZHENIIA OBLASTI BYSTROGO IZMENENIIA KHARAKTERISTIK SOLNECHNOI ATMOSFERY PO REZUL'TATAM RADIOASTRONOMICHESKIKH NABLIUDENII]
A. P. Molchanov Dec. 1964 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 158, no. 2, 1964 p 302–304
(Contract AF 19(628)-3880)
(T-R-460; AD-613981)

The radio radius of the sun R_1 (relative to the results of the photosphere R_2 is determined from radio observations of solar eclipses by finding the difference between the moments of contact of the lunar and solar disks recorded by radio and optical methods. This involves observations of the second and third contacts, near which the occulted area of the solar disk changes much more rapidly and R_2 can be determined much more precisely than when the first and fourth contacts are used. The data of several solar eclipses were used to determine R_1. TAB

N65-25535# American Meteorological Society, Boston, Mass.
OBSERVATIONAL DATA FROM THE ANNULAR SOLAR ECLIPSE OF 31 JULY 1962 [REZUL'TATY NABLIUDENIIA KOL'TSEOBRAZNOGO SOLNECHNOGO ZATMENIIA 31 IIULIIA 1962 G]
G. S. Veisg and A. P. Molchanov Dec. 1964 7 p refs Transl. into ENGLISH from Soln. Dannye 1963 (USSR), no. 11, 1963 p 58–61
(Contract AF 19(628)-3880)
(T-R-462; AD-613978)

Observations were made at Bamako in the Republic of Mali on the central line of the eclipse at a point with coordinates λ = 8° 00 min 06 sec W, ϕ = 12° 38 min 03 sec N, at 320 M above sea level. Information reported indicates that the following active formations were on the Sun on eclipse day and may have been associated with an increase in radio emission: four flocculi with an intensity of 1 and one flocculus with an intensity of 3. The coronal lines were weak and there were no sunspots or pores, but on the day before the eclipse the group of spots labeled no. 113 with a total area S_p = 12 was observed within the limits of the intense flocculus (the maximum value S_p = 92 was observed on 22 July). This group had disintegrated by eclipse time, but their source did continue to emit at λ 3.16 cm. The location of the source is marked on a figure, which also contains a synoptic map of the Sun, the path of the Moon, and the graphs of the eclipse (ephemeris time). TAB

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N65-24454# California Inst. of Tech., Pasadena.
RADIAL VELOCITIES OF DISTANT OB STARS Final Report
Guido Münch and Luis Münch (Carnegie Institution of Wash., D. C.) 1 Feb. 1964 14 p refs Submitted for Publication
(Grant Nonr(G)-0005-60)
(AD-430646)

The results of radial velocity measurements for 27 faint OB stars at galactic longitudes between l^{II} = 18° and l^{II} = 66° are presented. On the basis of spectroscopic absolute magnitudes in the Yerkes system and (U, B, V) photometry, the rotational velocities of the stars around the galactic center were derived. In comparison with the rotational curve indicated by the interstellar neutral hydrogen, the stellar motions suggest rotational velocities lower by about 25 km/sec at distances from the center around half that of the sun. The general shape of the rotation curve provided by the new stellar observations remains thus the same as it was found in a previous study. Author

N65-24469# Army Map Service, Washington, D. C.
HORIZONTAL AND VERTICAL CONTROL FOR LUNAR MAPPING. PART TWO: AMS SELENODETIC CONTROL SYSTEM 1964
Sam Breece, Marian Hardy, and Marvin Q. Marchant Mar. 1964 161 p refs
(TR-29; AD-460485)

The largest fundamental selenocentric control adjustment ever obtained from astronomical research was completed. The control contains almost twice as many points as, and covers 30% more area than, any previous adjustment. There are 256 points in an equal-area distribution over the portion of the moon visible from the earth. The average point was measured on six photographic plates. The rms horizontal and vertical uncertainties of the system are, respectively, ±1094 and ±858 meters. The data will be refined through a determination of the radius and figure of the moon based on the new control system. Author

N65-24471# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A TRANSFER MANEUVER BETWEEN TWO NONCOPLANAR ELLIPTICAL ORBITS
M. M. Nita 22 Mar. 1965 22 p refs Transl. into ENGLISH from Studii Cercetari de Mecanica Aplicata (Bucharest), v. 14, no. 3, 1963 p 573–589
(FTD-TT-64-1122/1+2+3+4; AD-460499)

Paper deals with a maneuver which allows modification of the plane of an elliptical orbit, the form of the orbit remaining unchanged. A constant ratio between the thrust and the satellite mass and an invariable space direction of the engine axis are considered. Under this hypothesis, previous results are used to analyze a maneuver which permits uniformly circular motion in a plane which does not include the earth's center. Variation formulas for the final elements of the orbit are then given and it is shown that the maneuvering plane orientation and engine thrust are functions of the initial orbit eccentricity. For each orbit with a given eccentricity, there are two possible types of maneuver. Extreme values of the final inclination of the orbit are established. Author

N65-24476 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN PROBLEMS OF ASTRODYNAMICS AND CELESTIAL MECHANICS
G. N. Duboshin and D. Ye. Okhotsimskiy *In its* Cosmic Res. 6 Feb. 1964 p 1–29 Presented at the 14th Intern. Astronautical Congr., Paris, 25 Sep.–1 Oct. 1963 (See N65-24475 14-29)

Characteristics of the basic problems of classical celestial mechanics and of certain problems of astrodyanmics are given. Interrelationship between these branches of science is considered. Problems in the design of orbits are discussed as are certain questions of terminology. Author

N65-24478 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPARENT MOTIONS OF THE EARTH IN THE LUNAR SKY
V. V. Shevchenko *In its* Cosmic Res. 6 Feb. 1964 p 44–50 refs (See N65-24475 14-29)

General nature of the apparent motions of the earth in lunar ecliptical and horizontal systems of coordinates is explained. Formulas are derived for compiling of ephemerides. Author

N65-24479 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TWO-DIMENSIONAL PROBLEM OF ESTABLISHING A TRUE INDICATRIX OF BRIGHTNESS BASED ON THE MEASURED SMOOTHED INTENSITY
A. A. Dmitriev *In its* Cosmic Res. 6 Feb. 1965 p 51–60 ref (See N65-24475 14-29)

The one-dimensional problem previously considered is generalized to a two-dimensional field. Possibility of establishing true brightness from measured smoothed brightness is demonstrated in the case of a II-type function of the distribution of the sensitivity of an instrument within a given solid angle, and when the function decreases rapidly from the point of sight. Author

N65-24480 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SCATTERING OF LIGHT IN A SPHERICAL ATMOSPHERE. II
I. N. Minin and V. V. Sobolev *In its* Cosmic Res. 6 Feb. 1964 p 61–73 refs (See N65-24475 14-29)

Light scatter study in a planetary atmosphere taking into account the curvature of the atmospheric layer is continued. The case where the absorption coefficient is constant in the atmosphere is examined. An analytic solution of the basic equation determining the value of J is obtained. Light reflection from the surface of the planet is taken into account. Formulas are given for determining the intensity of radiation leaving the atmosphere. The derived solution is applied to the case of the luminosity of a homogeneous sphere. A formula for determining the intensity of radiation leaving a homogeneous sphere after single diffusion is considered in detail. From this are obtained asymptotic formulas for large values of the optical radius of the sphere. Author

N65-24482 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DEMAND FOR ACCURACY IN OBTAINING METEOROLOGICAL INFORMATION FROM ARTIFICIAL EARTH SATELLITES
B. M. Novikov and V. A. Zyabrikov *In its* Cosmic Res. 6 Feb. 1964 p 97–107 refs (See N65-24475 14-29)

Requirements are established which must be considered when developing equipment to use on weather satellites for determinating cloud cover, air temperature, and temperature of the underlying surface. Proceeding from the problems of analyzing and forecasting meteorological conditions, an evaluation is made of the magnitude of the minimum necessary area of the resolving element when photographing cloud fields, and the indexes of accuracy in the determination of the temperature of the air at different heights and of the underlying surface are calculated. Authr

N65-24484 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
UPPER ATMOSPHERIC DETECTION OF O^+ IONS WITH HIGHER THAN THERMAL ENERGY
V. G. Istomin *In its* Cosmic Res. 6 Feb. 1964 p 116–127 refs (See N65-24475 14-29)

In measurements of the ionic composition of the atmosphere on a spherically oriented container, the radiofrequency mass spectrometer, being in the region of the molecular shadow at a height of 250 km, recorded a considerable number of O^+ ions on the downward leg of the trajectory. This apparently indicates excess of velocities of O^+ ions the basic ionized component of the F_2 region, over the thermal velocities of the neutral atmospheric components. It is possible to interpret the detected effect as the existence both of a directed displacement of O^+ ions (downward or horizontally) having velocities of the order of 10^5 cm-sec^{-1} and of a random motion of O^+ ions having high velocities. Author

N65-24499# Lockheed Missiles and Space Co., Sunnyvale, Calif.
TRAJECTORY, VOLUME 3, NUMBER 1, FALL 1963
W. R. Hilbrink, ed. et al 1963 60 p

A short description of NASA's responsibilities and wide ranging activities in research studies in engineering and technology, in teamwork with industry, and in international cooperation is given. Some of the articles discuss Gemini, Cape Kennedy, and the RIFT program. G.G

N65-24526 Joint Publications Research Service, Washington, D. C.
THE VENUS MODEL WITH A "COLD" ABSORBING ATMOSPHERE
A. D. Kuz'min *In its* Izv. VUZov: Radiophys., Vol. VII, No. 6, 1964 13 May 1965 p 1–16 refs (See N65-24525 14-07) CFSTI: $7.00

The possibility of interpreting observed radiation spectrum of Venus in the centimeter and millimeter ranges by absorption in the aerosol atmosphere of the planet is analyzed. It is shown that the steep rise in the millimeter region of the spectrum can be explained by absorption in the liquid-mist aerosol

at about 300° K and containing 0.2 to 0.3 gm/cm^2 polar liquid with about 3.5×10^{-12} sec relaxation time. Such liquids may be certain functional derivatives of methane, ethane and benzene. The aerosol dust, of mountainous and volcanic origin, has not yielded satisfactory experimental data. It is shown that an atmosphere with the given radiation spectrum must be perfectly opaque in the infrared and visible region. Therefore, direct solar radiation cannot be the source from which the planet surface is heated. Surface heating due to inner heat of the planet is considered and heat flow necessary for this estimated. It is pointed out that the measured decrease in the brightness temperature of Venus in the decimeter range may be possibly explained by absorption in the relatively cold (about 300°K) ionosphere of the planet. The necessary conditions for this electron concentration in the porous ionosphere and the collision frequency in the semitransparent ionosphere are evaluated. Author

N65-24562*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPUTATION OF GENERAL PLANETARY PERTURBATIONS, PART II: A COMPARISON OF COMPONENTS
Lloyd Carpenter Washington, NASA, Jun. 1965 9 p refs
(NASA-TN-D-2852) CFSTI: HC $1.00/MF $0.50

The components of the planetary perturbations in rectangular coordinates are given as series expansions in the well-known Hansen components. The results provide formulas for transforming a general theory in one set of components into the corresponding general theory in the other set of components by simple series multiplications. The results suggest a useful method of improving the convergence of successive approximations when computing perturbations in the rectangular coordinates. Author

N65-24563*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE EVALUATION OF TWO METHODS OF SURVEYING STAR BACKGROUNDS FOR SPACE MISSION SIMULATORS
Burnett L. Gadeberg Washington, NASA, Jun. 1965 32 p
(NASA-TN-D-2856) CFSTI: HC $2.00/MF $0.50

The first method requires no prealinement or measurement of the simulator. Sights of a reference cross establish orientation of the basic coordinate system and relative dimensions of all pertinent components of the simulator. When these dimensions are combined with sights of the simulated stars, their relative positions are determined. If the reference cross is constructed with arm dimensions known in terms of a standard arm length, all dimensions determined by the survey are given in terms of that length. The second method, which makes use of fewer observations, requires that the survey instrument be prealined with the simulator coordinate system about which the cab angle instrumentation is oriented. All dimensions are given in terms of the distance between the simulator center of rotation and the survey instrument. Both systems produce similar results whose standard deviations are slightly larger than those of the observations when a minimum of data is used. Both may also be used for resurveying without interruption during an extended simulator run. Author

N65-24565*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE THERMAL ENVIRONMENT OF THE TERRESTRIAL PLANETS, SUPPLEMENT 5
Klaus Schocken 28 Apr. 1965 20 p refs
(NASA-TM-X-53241) CFSTI: HC $1.00/MF $0.50

Using a balloon-telescope vehicle, a reflection spectrum of the clouds of Venus was obtained. The conclusion can be drawn that the reflecting cloud layer on Venus is composed of particles of frozen water. In Venus spectrograms, no Doppler-shifted O_2 lines were found. The decrease of the flux of micrometeorites between the neighborhood of the Earth and interplanetary space by 4 orders of magnitude is an indication of the existence of a dust cloud near the Earth. Surfaces which reproduce the lunar light scattering curve were prepared. It was found that any dark powder can be used for this purpose, provided the grains are of the order of a few microns in size and are shaken through a grating on a surface so that they will fall individually. The grains stick to other grains on contact, since the van der Waals forces will be more important than the gravitational forces. It appears likely that the lunar surface layer possesses a structure of this type. Determination of the surface pressure of the Mars atmosphere yields 17 ±3 mB. Spectral measurements of the solar X-ray emission were made with a crystal spectrometer in an Aerobee rocket. No line was detected below 13 Å. Author

N65-24566*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MEASUREMENT RELATIONSHIPS FOR PEGASUS-TYPE METEOROID EXPERIMENTS
Charles C. Dalton 5 May 1965 33 p refs
(NASA-TM-X-53255) CFSTI: HC $2.00/MF $0.50

In Pegasus-type meteoroid measurement satellite experiments, where vehicle attitude information is available without information about the meteoroid closing velocity vector, the probable radiant and the puncture flux enhancement factor for sporadic meteors should be based on the assumption that velocity vectors for ambient meteoroids are isotropically distributed. Then, although half of the meteoroids which impact onto a flat transducer are more than 45° from the normal, those within 45° puncture three times more effectively than the others, and half of the puncturing meteoroids are less than 33.5° from the normal when the earth is below the surface horizon. This distribution also implies that the flux of puncturing meteoroids is five times greater than the flux of incident meteoroids with mass equal to or greater than the mass of the almost-puncturing meteoroid with the average values of density, velocity, and impact angle. Formulas for the celestial coordinates of the probable radiant of a puncturing meteoroid were corrected for earth-shielding. This correction is important near the earth even under nominal circumstances. Author

N65-24634# Royal Observatory, Edinburgh (Scotland).
REPORT OF THE ASTRONOMER ROYAL FOR SCOTLAND FOR THE YEAR ENDING 31 MARCH 1965
H. A. Brück [1965]

Continued research in astrophysics conducted under the Stellar Astronomy and Astrophysics Division, Astronomical Instrumentation Division, Space Research Division, and Seismology Division of the Observatory is reported. Included are data on interstellar obscuration and polarization, night sky photometry, rocket and satellite astronomy, tracking of artificial satellites, and equipment for recording and playing back seismic data on multichannel magnetic tapes. A list of publications of the Royal Observatory is also included. S.C.W.

N65-24659*# National Aeronautics and Space Administration, Washington, D. C.
ON POLAR ORBITS OF THE EARTH'S ARTIFICIAL SATELLITES [O POLYARNYKH ORBITAKH ISKUSSTVENNYKH SPUTNIKOV ZEMLI]

E. P. Aksenov, E. A. Grebenikov, and V. G. Demin Dec. 1962 18 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. Fiz.-Astron. (Moscow), no. 5, 1962 p 81–89
(NASA-TT-F-8338) CFSTI: HC $1.00/MF $0.50

Potential of terrestrial attraction is approximated by the potential of two attraction centers situated at a certain imaginary distance. Qualitative analysis of the form of motion is made. The most interesting case for applications is studied in detail. Author

N65-24663*# National Aeronautics and Space Administration, Washington, D. C.
INTERACTION OF RADIO WAVES IN THE IONOSPHERE [K VOPROSU O VZAIMODEYSTVII RADIOVOLN V IONOSFERE]
I. M. Vilenskiy Oct. 1962 10 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 5, no. 3, 1962 p 468–472
(NASA-TT-F-8307) CFSTI: HC $1.00/MF $0.50

A series of formulas are derived to demonstrate that the interaction in the ionosphere between a strong amplitude-modulated and a weak nonmodulated wave affects not only the absorption but also the dielectric constant, and as a result the weak wave becomes not only amplitude modulated but also phase modulated. The formulas are considered sufficiently accurate when transmitter power does not exceed 100 to 200 kw. Although investigations made both during the day and at night are in agreement with the computed data, it is stressed that the calculations should be considered as having only a general indicative value. Author

N65-24664*# National Aeronautics and Space Administration, Washington, D. C.
ORBIT OF AN EQUATORIAL SATELLITE OF THE EARTH [ORBITA EKVATORIALNOGO SPUTNIKA ZEMLI]
V. V. Beletskiy Dec. 1962 14 p refs Transl. into ENGLISH from Iskusstv. Sputniki Zemli (Moscow), v. 13, 1962 p 53–60
(NASA-TT-F-8347) CFSTI: HC $1.00/MF $0.50

Considered are the properties of the earth's equatorial satellite trajectories and the behavior of the orbit's osculating elements, through the solution of the problem of motion of a point in the equatorial plane of an oblate ellipsoid expressed in the elliptical functions. This solution shows that a circular orbit in osculating elements is circumscribed by an ellipse rotating with an angular velocity while the satellite is always in the perigree of that ellipse. It was concluded that the equation for precise transition from the time argument to the true anomaly is preferable for great perturbations, and that an inaccurate substitution of variables may lead to errors in the consideration of osculating elements of a perturbed motion even for small perturbations. G.G.

N65-24707# Bureau des Longitudes (France).
AERONAUTICAL ALMANAC, MAY TO AUGUST 1965 [EPHEMERIDES AERONAUTIQUES, MAI A AOUT 1965]
André Gougenheim Paris, Blondel La Rougery, 1965 333 p In FRENCH

Aeronautical ephemerides are published to give aviators, in a simple form, the elements necessary for determining the position of an aircraft in flight by astronautical navigation methods. The values are given in rounded minutes of arc, which are sufficiently precise, except for the Sun and the siderial angle. Following hourly tables of the positions of the Sun, Mars, Jupiter, Saturn, and the Moon for the months May through August 1965, an explanation of the use of ephemerides and various schemes and tables are presented. M.P.G

N65-24717*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
ENGINEERING LUNAR MODEL OBSTACLES (ELMO)
J. R. Olivier and R. E. Valentine 8 Mar. 1965 56 p
(NASA-TM-X-56451; TR-145-D) CFSTI: HC $3.00/MF $0.50

This report presents an analytical procedure for determining the energy required by a lunar roving vehicle for negotiating small obstacles. Some results of a limited parametric analysis generated by use of this procedure are included. Energy requirements are calculated for a typical vehicle to illustrate the use of the data, and to establish a base line value. Author

N65-24726# European Space Vehicle Launcher Development Organization, Paris (France). Basic Techniques Div.
INJECTION ACCURACY FOR THE SYNCHRONOUS ORBIT
E. Cambi Mar. 1965 11 p
(ELDO-TM-F-15)

An injection error, analyzed into three components of a vector position error, and three components of a vector velocity error, gives origin to an error motion of a potentially synchronous satellite in respect to the desired station. This error motion is analyzed into a bias position error; constant drift; and a tridimensional oscillation. Simple analysis gives the quantitative values of the amplitudes of these components as a function of the initial inaccuracy. Author

N65-24729*# California Inst. of Tech., Pasadena. Div. of Geological Sciences
PHOTOMETRY OF THE EARTH FROM MARINER II
Robert L. Wildey Aug. 1964 22 p refs
(Contract NAS7-100; Grant NsG-56-60)
(NASA-CR-63097) CFSTI: HC $1.00/MF $0.50

The Earth tracking system aboard the Mariner II spacecraft has collected photometric observations of the Earth as a byproduct of its navigational duties on the flight to Venus. The observations show good agreement with the phase curve for the Earth that was previously found by observing the earth-lit Moon. Diurnal variations in brightness are correlated with the fraction of the Earth's disk covered by land. Author

N65-24761# European Space Vehicle Launcher Development Organization, Paris (France).
LIBRATIONS OF A SATELLITE [LIBRATIONS D'UN SATELLITE]
E. Cambi May 1965 50 p refs In FRENCH
(ELDO-TM-F-13)

A classical formulation of the problem of librations of a satellite in orbit gives, in a very direct way, results already known to others but discussed in the literature using very complicated methods. The relative simplicity of the formulation further allows a very clear presentation of the results. The formal study is preceded by a general discussion of the stability and the use of the Hamiltonian as a function of Liapunov. Transl. by M.P.G.

N65-24774*# National Aeronautics and Space Administration Washington, D. C.
DESCRIPTIONS OF OBSERVATIONS OF LUNAR VOLCANOES IN THE 18TH AND EARLY 19TH CENTURIES [OPISANIYA NABLYUDENIY VULKANOV NA LUNE v XVIII I NACHALE XIX vv]
T. N. Klado Jun. 1965 15 p refs Transl. into ENGLISH from Istoriko-Astron. Issled. (USSR), v. 6, 1 Jan. 1961 p 263–278
(NASA-TT-F-310) CFSTI: HC $1.00/MF $0.50

The outstanding theories of the last 200 years on the question of the existence of lunar volcanoes, from Herschel to present are presented. The propositions of leading investigators are compared as represented by their own documents and letters, in which they defend their own propositions, describe their research methods and findings, and refute or defend others. Explanations are offered in perspective, to disprove past theories defending lunar volcanism. Author

N65-24872# European Space Vehicle Launcher Development Organization, Paris (France).
CLASSIFICATION OF MISSIONS OF SPACE VEHICLES LAUNCHED IN THE UNITED STATES [CLASSIFICATION DES MISSIONS DE VEHICULES SPATIAUX LANCES AUX ETATS-UNIS]
M. Gilli Jan. 1965 14 p In FRENCH
(ELDO-TM-F-14)

Tables giving the principal characteristics of missions carried out by space vehicles launched by the United States are given. Each table groups as many as possible of the satellites launched by the same launcher and, wherever possible, gives an indication of the source of electrical energy onboard the space vehicle. The different tables are devoted to purely scientific satellites, meteorological satellites, communications and navigation satellites, satellites with heavy low orbits, space probes, as many military satellites as known, and others including examples of multiple launchings by the same launcher. M.P.G

N65-24873# European Space Vehicle Launcher Development Organization, Paris (France). Basic Techniques Div.
CLASSIFICATION OF MISSIONS OF SPACE VEHICLES LAUNCHED IN THE USSR [CLASSIFICATION DES MISSIONS DES VEHICULES SPATIAUX LANCES EN URSS]
M. Gilli Mar. 1965 16 p refs In FRENCH
(ELDO-TM-F-16)

The principal Soviet missions carried out with space vehicles are tabulated. An attempt at evaluation of the actual launchers is given, based on limited public information available. The missions are grouped in tables for purely scientific satellites, biologic satellites, manned satellites, reconnaissance satellites, and lunar and space probes. A chronological capitulation of missions from 1957 to 1964 is included. M.P.G.

N65-24882 Joint Publications Research Service, Washington, D. C.
HOW WERE THE COMETS DISCOVERED?
Yu-che Chang *In its* Transl. on Communist China's Sci. and Technol., No. 181 25 May 1965 p 17–20 Transl. into ENGLISH from K'o-hsueh Ta-chung (China), no. 3, Mar. 1965 p 17–18 (See N65-24879 14-34) CFSTI: $3.00

Recent discovery of two comets within 10 days at a Chinese observatory is discussed. Their instrument is a double telescopic camera whose structure is similar to that of opera glasses, and which is used routinely for study of planetoids in time-exposure photographs. The comets were distinguished by their misty appearance, which is unlike the clear dots of stars and the short dashes that represent planetoids. It is stated that if an amateur astronomer searches the sky regularly with a simple telescope, he will see perhaps 10 comets in his lifetime. A brief account of Halley's prediction of the pattern of return of the comet later named after him is given. J.M.D.

N65-24895*# RAND Corp., Santa Monica, Calif.
USE OF RADIATION GAUGING METHODS TO MEASURE ATMOSPHERIC DENSITY DURING MARTIAN ENTRY
J. W. Ranftl Apr. 1965 81 p refs
(Contract NASr-21)
(NASA-CR-62971; RM-4434-NASA) CFSTI: HC $3.00/MF $0.75

Conclusions made on the basis of this study are these: Except for the remoteness of the location and unknown factors in composition, the Martian atmosphere gaging problem is similar to that of gaging the density of the terrestrial atmosphere from a rapidly moving vehicle. (2) Of techniques available, X-ray backscattering with an electrically generated, continuously operating source of radiation appears most promising for gaging atmospheric density in the range 10^{-8} to 10^{-3} gm/cm^3. This range extends from those densities significant in entry effects (the lesser value) to the estimated near-surface density of Mars (the greater value). Use of an electron beam, generating soft X-rays (bremsstrahlung), is suggested as an auxiliary technique for gaging in the range 10^{-12} to 10^{-8} gm/cm^3, with a possible extension to 10^{-7} gm/cm^3 to overlap the X-ray range. Author

N65-24908# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board
UNITED STATES SPACE SCIENCE PROGRAM, REPORT TO COSPAR
1963 290 p refs Presented to the 6th Meeting of COSPAR, Comm. on Space Res., Warsaw, 3 Jun. 1963

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N65-24909 National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board
ASTRONOMY
In its U.S. Space Sci. Program, Rept. to COSPAR 1963 p 1–9 (See N65-24908 14-30)

Current United States astronomy activities associated with studies of galactic space are reviewed generally. Studies of stellar ultraviolet radiation, X-ray studies with Geiger counters aboard Aerobee-150 rockets, a series of balloon investigations of primary gamma radiation, gamma ray studies with the Explorer XI satellite and the NASA Orbiting Solar Observatory, Journeyman rocket investigation of cosmic radio waves, the development of the Orbiting Astronomical Observatory to be placed in a low circular earth orbit, and various ground-based astronomy programs are discussed. J.M.D.

N65-24913 National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board
PLANETARY ATMOSPHERES AND METEOROLOGY
In its U.S. Space Sci. Program, Rept. to COSPAR 1963 p 50–71 ref (See N65-24908 14-30)

Distribution and structure of the ionized layers in the earth's atmosphere are described. Research in which the principal phenomena under study are concerned with energetic charged particles, fields and interactions with extraterrestrial influences is presented. Aeronomical investigations are reported, i.e., of temperature, density, neutral and ionic composition, aerosols, the time and space variations of all these, mass motions, and reactions with solar radiation; also meteorological studies defined as those emphasizing the larger-scale dynamical systems involving the interplay of the foregoing parameters through heat exchange, mass transport, over large geographical areas. Results from planets other than the earth are also reported if the data apply unquestionably and exclusively to their atmospheres. Author

N65-24914 National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board
PLANETOLOGY
In its U.S. Space Sci. Program, Rept. to COSPAR 1963 p 72–84 (See N65-24908 14-30)

Various planet and meteorite studies are reported. Infrared spectrometer data from Stratoscope II, a 36-inch telescope aboard a balloon, revealed that the Mars atmospheric water vapor content is less than $5 \times 10^{-3} g/cm^2$. The Mariner II mission between August and December 1962 yielded microwave radiometer information that indicates the Venus surface temperature to be of the order of 700° K, and its magnetometer transmitted data that show the Venus magnetic field to be probably not more than one-tenth that of Earth. Radar observation of Venus indicates that the planet is rotating slowly and that the surface is rather smooth. A study of the atmosphere of Jupiter by a ground-based infrared spectrometer has confirmed the carbon dioxide band at 1.5 microns. A geological map of the Moon revealed 14 types of rocks. Photometric results from laboratory studies of simulated lunar surface conditions indicate that very small scale surface structures are in closest agreement with the lunar reflectivity curves. Satellite and ground-based studies of meteors and meteorites are reviewed briefly.
J.M.D.

N65-24916 National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board
CELESTIAL MECHANICS, TRAJECTORY STUDIES, GEODESY, AND GRAVITY
In its U.S. Space Sci. Program, Rept. to COSPAR 1963 p 99–105 refs (See N65-24908 14-30)

Objectives and results are summarized for studies of solar parallax measurement, earth and lunar orbit computation, effect of rocket charge drag on orbital height, relativistic correction in Doppler shift for planet Venus, trapping of cosmic dust in Earth orbit, capture of balloon satellite in lunar orbit, and approach to optimal thrust of vertically ascending rocket. Project ANNA, based on the ANNA I-B satellite bearing optical flashing-light beacon, radio range transponder, radio Doppler system, to calibrate these satellite systems against each other and to gain geodetic information, is described. Various other studies of gravitation and of trajectory design and optimization are mentioned. J.M.D.

N65-24917 National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board
LABORATORY ASTROPHYSICS AND RELATED SUBJECTS
In its U.S. Space Sci. Program, Rept. to COSPAR 1963 p 106–108 (See N65-24908 14-30)

Numerous laboratory studies in astrophysics are reported. Study objectives and results are summarized for (1) programs in critical analysis of ionization potentials and dissociation energies of various diatomic molecules and molecular ions of astrophysical significance, (2) measurement of absolute absorption and relative photoionization cross section of molecular oxygen with a scanning vacuum ultraviolet monochromator, (3) numerical determination of microwave interaction with plasma slabs having arbitrary electron density and collision frequency profiles, (4) effect of space environment on the reflectivity of various materials used for thermal control surfaces, (5) measurements of surface erosion of a satellite surface exposed to space environment, (6) determination of meteor collision hazard to vulnerable parts of spacecraft and evaluation of impact flash phenomena, and (7) impact studies with small particles propelled at meteor velocities. J.M.D.

N65-24920 National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board
INTERNATIONAL ACTIVITIES
In its U.S. Space Sci. Program, Rept. to COSPAR 1963 p 116–130 (See N65-24908 14-30)

International exchange of space research information is described. The United States is cooperating with more than 60 countries in actual flight experiments, in ground-based support of orbiting experiments, and in cooperative training programs; a chart outlines these activities and names the participating countries. Successful launchings of sounding rocket experiments during 1962, involving United States cooperation with eight countries, and experiments by five other countries planned for 1963, are outlined. An international data center prepares and circulates every six months a catalog of rocket and satellite data; a listing of 21 reports in the IGY Rocket and Satellite Reports series is given. A bibliography of United States reports and papers in space sciences is included for 1962. Also, a revised list of journals in which United States reports on space research are normally published is posted in an appendix. J.M.D.

N65-24926# Smithsonian Institution, Washington, D. C.
REPORT ON THE ASTROPHYSICAL OBSERVATORY
Fred L. Whipple *In its* Ann. Rept. of the Smithsonian Inst., 1962 [1962] p 71–93 (See N65-24925 14-34) GPO: $4.75

Operations of the two Divisions of the Astrophysical Observatory are described. The Division of Astrophysical Research

in Cambridge, Mass. for the study of solar and other types of radiation impinging on the earth has made significant contributions to research on solar astrophysics, meteors, meteorites, artificial satellites, geophysics, and space science. The Division of Radiation and Organisms in Washington, D.C. for the investigation of radiation as it relates directly or indirectly to biological problems has studied phototropic responses, light-dependent chloroplast maturation, excitation of chlorophyll fluorescence, influence of chloramphenicol on photosynthetic processes, physiological basis for changes in X-ray sensitivity of maize chromosomes, reversal of red light induction by far-red radiation, and related research. Publications and other staff activities are also reported for each Division. M.P.G.

N65-24931# Smithsonian Institution, Washington, D. C.
ANNUAL REPORT OF THE SMITHSONIAN INSTITUTION, 1963
Washington, GPO [1964] 694 p refs
(Publ.-4530) GPO: $4.25

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18. THE SMITHSONIAN'S SATELLITE-TRACKING PROGRAM: ITS HISTORY AND ORGANIZATION, PART 2 E. N. Hayes p 331–357 refs (See N65-24937 14-30)

19. THE NEUTRINOS Melvin Schwartz (Columbia Univ.) p 359–368 ref

20. THE ANTIBIOTICS FROM A BOTANICAL VIEWPOINT Kenneth L. Jones (Michigan Univ.) p 369–380 refs

21. ATOMIC AND OTHER WASTES IN THE SEA I. Eugene Wallen p 381–400 refs

22. WHAT IS CYBERNETICS? Donald M. MacKay (Keele Univ., England) p 401–408

23. THE USE OF THE ELECTRON MICROSCOPE IN THE STUDY OF FOSSILS William W. Hay (Illinois Univ.) p 409–416 ref

24. COLOR CHANGES IN ANIMALS D. B. Carlisle (Anti-Locust Res. Center, London) p 417–426

25. HISTORY OF THE CORBIN PRESERVE Richard H. Manville (U.S. Fish and Wildlife Service) p 427–446 refs

26. THE SOUTHERN OCEAN: A POTENTIAL FOR CORAL STUDIES Donald F. Squires p 447–460

27. THE PROMISE OF UNDERWATER ARCHEOLOGY George F. Bass (Pennsylvania Univ.) p 461–472

28. PLANTS IN THE ARCTIC-ALPINE ENVIRONMENT Stanwyn G. Shetler p 473–498 refs

29. CONCERNING WHALES AND MUSEUMS A. E. Parr (Am. Museum of Natural History) p 499–502 refs

30. TROPICAL SUBSISTENCE AGRICULTURE IN LATIN AMERICA: SOME NEGLECTED ASPECTS AND IMPLICATIONS Raymond E. Crist (Florida Univ.) p 503–520 refs

31. AN ARCHEOLOGICAL RECONNAISSANCE IN HADHRAMAUT, SOUTH ARABIA—A PRELIMINARY REPORT Gus. W. Van Beek, Glen H. Cole, and Albert Jamme (Catholic Univ. of America) p 521–546 refs

32. THE CORROSION PRODUCTS OF METAL ANTIQUITIES Rutherford J. Gettens p 547–568 refs

33. RELIGIOUS ART EAST AND WEST Benjamin Rowland (Harvard Univ.) p 569–585

N65-24932# Smithsonian Astrophysical Observatory, Cambridge, Mass.
REPORT ON THE ASTROPHYSICAL OBSERVATORY
Fred L. Whipple *In* Smithsonian Inst. Ann. Rept. of the Smithsonian Inst., 1963 [1964] p 147–179 refs (See N65-34931 14-30) GPO: $4.25

Discussed is work on solar and other types of energy impinging on the earth and the investigations of radiation as it relates directly or indirectly to biological problems. Planetary sciences studies are based on the precise satellite data obtained by the network of Baker–Nunn cameras, laboratory studies of atomic collision processes, theoretical studies of the atmosphere and surfaces of other planets, and other related investigations. Exobiology studies pertained to a simulated Martian environment. Lunar sciences investigations related to past and forthcoming lunar probes, orbiters, softly landed instrument packages, and eventual manned exploration. Meteoric sciences research was conducted on the meteoric matter in the solar system, and observations of meteors. G.G.

N65-24933# Manchester Univ., Macclesfield (England).
THE SOLAR SYSTEM
Bernard Lovell *In* Smithsonian Inst. Ann. Rept. of the Smithsonian Inst. 1963 [1964] p 279–292 (See N65-34931 14-30) GPO: $4.25

The many problems of the solar system are discussed after a brief review of the basic astronomical data. Interplanetary space is defined as a medium where the complex radiations, ionized particles, and magnetic forces determine the geophysical environment of the earth and the planets. Several new concepts are expressed for studies on the solar atmosphere, one of which associates the formation of an aurora with the draining of solar particles from the outer Van Allen belt during a magnetic storm. Also discussed are meteors or shooting stars, radio-astronomical studies of the moon and the planets, and theories on the origin of the solar system. G.G.

N65-24934# Arizona Univ., Tucson. Steward Observatory
ADVANCES IN ASTRONOMICAL TECHNOLOGY
Aden B. Meinel *In* Smithsonian Inst. Ann. Rept. of the Smithsonian Inst., 1963 [1964] p 293–300 Repr. from the Indian and Eastern Engr., Anniv. No. 104, 1962 (See N65-24931 14-30) GPO: $4.25

Faintness and small angular size constitute the unusual characteristics that astronomical instrumentation and research have to consider. Available photoelectric devices utilize about 30% of the incident light and can be used to determine the position, motion, and brightness of celestial objects. The principal auxiliary instruments currently used on a telescope are the photoelectric photometer and spectrometer, the photographic spectrograph, the photographic camera, and the image intensification tube. Their efficiency can be improved by increasing the size of the telescope mirror, and the efficiency of the detector; by decreasing the aperture and thereby the night sky noise at the detector; and by placing the telescope above the atmosphere by a high balloon or a satellite. G.G.

N65-24935# Royal Greenwich Observatory, Herstmonceux (England).
THE ANALYSIS OF STARLIGHT
Bernard Pagel *In* Smithsonian Inst. Ann. Rept. of the Smithsonian Inst., 1963 [1964] p 301–321 Repr. from the Advan. of Sci. (London), v. 19, no. 82, Mar. 1963 (See N65-24931 14-30) GPO: $4.25

The examination of color-luminosity diagrams of the two main stellar populations existing in the Galaxy at large and also in the neighborhood of the earth, together with an evaluation of several theories that have been developed led to the suggestion that the chemical elements in the universe were formed by nuclear synthesis from hydrogen, helium, and neutrons in the interiors of hot stars which then exploded as supernovae. Scattering of the newly formed heavy elements into the interstellar medium led to the formation of new generations of stars. Examination of the physical and chemical properties of stars near us by photometry through colored glass filters, and spectral classification from low-resolution spectra resulted in extensive lists that give the spectral types and color indices for thousands of stars. To obtain more reliable results, supplementation of these lists by spectra of high resolving powers, and the examination of the weak lines as well as the strong lines is advocated. G.G.

N65-24936# Princeton Univ., N. J.
ASTRONOMICAL PHOTOGRAPHY FROM THE STRATOSPHERE
Martin Schwarzchild *In* Smithsonian Inst. Ann. Rept. of the Smithsonian Inst., 1963 [1964] p 323–329 (See N65-34931 14-30) GPO: $4.25

Described are the astronomical balloon Project Stratoscope I and II observations by telescope to obtain high definition photographs of sample areas on the solar surface without the garbling influence of the Earth's atmosphere. Several hundred high definition solar photographs from Project Stratoscope I flights contained detailed pictures of the granulation, both in undisturbed and in highly disturbed magnetic regions, as well as full time sequences of both types of areas. Subsequent analysis determined the distribution of sizes of convective elements in the solar atmosphere and the average period of time that a typical convective element exists. Observations with Stratoscope II balloon flights utilizing a 36-inch aperture telescope found a number of traces of the infrared spectrum of Mars, but encountered some technical difficulties. G.G.

N65-24937# Smithsonian Astrophysical Observatory, Cambridge, Mass. Editorial and Publications Div.
THE SMITHSONIAN'S SATELLITE-TRACKING PROGRAM: ITS HISTORY AND ORGANIZATION, PART 2
E. Nelson Hayes *In* Smithsonian Inst. Ann. Rept. of the Smithsonian Inst., 1963 [1964] p 331–357 refs (See N65-24931 14-30) GPO: $4.25

The satellite-tracking program is traced from the first actual activation of the Moonwatch network after the launch of Sputnik I in October, 1957 up to July, 1958, at which time all 12 Baker–Nunn camera stations were operational on a worldwide basis. An orbit determination program was developed from a so-called subsatellite program, and was 90% effective in producing orbits from sets of observations chosen at random. Predictions consisted of an ephemeris giving the time and longitude of all crossings of the 40th parallel; and an ephemeris giving more detailed and specific information for special observation teams. Both ephemerides were programed for the IBM 704 computer. A short review of the Vanguard project is included. G.G.

N65-24983*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE JOVIAN ENVIRONMENT
Lawrence M. Trafton 8 Mar. 1962 28 p refs
(Contract NAS7-100)
(NASA-CR-63116; JPL-TM-33-77) CFSTI: HC $2.00/MF $0.50

Quantitative knowledge of the Jovian atmosphere and the environment above the atmosphere is summarized. Topics covered include composition and structure of the atmosphere, photometric properties of the atmosphere, period of rotation, magnetic field, and the Jovian radiofrequency spectrum.
Author

N65-25003*# IIT Research Inst., Chicago, Ill. Astro Sciences Center
A STUDY OF INTERPLANETARY SPACE MISSIONS
D. L. Roberts 15 Mar. 1965 108 p refs *Its* Rept.-M-6
(Contract NASr-65(06))
(NASA-CR-62889) CFSTI: HC $4.00/MF $0.75

A survey of interplanetary space exploration, which was initiated with a previous investigation of the scientific objectives of solar system exploration, is reported. The gross requirements for interplanetary missions are discussed in respect to the following mission profiles: ecliptic to 5.2 AU; absolute min. ΔV to $\beta = 13.5$ lat; absolute min. ΔV to $\beta = 22°$ lat; and min. ΔV to $r = 3$ AU, $\beta = 15°$. The launch vehicles assumed for the missions are the Atlas Centaur and the Saturn 1B. Emphasized is the region of space between heliocentric radii of 0.5 AU and 5 AU, and heliocentric latitudes of $\pm 50°$. Included are data on the scientific objectives, a basic experimental payload, guidance propulsion, trajectory, and communications requirements. Suggestions are made for constructing multiple missions where the value lies in obtaining data simultaneously from two or more predetermined positions in space. Speculation is made concerning the influence of this approach on the present knowledge of the propagation of irregular zones through interplanetary space.
S.C.W.

N65-25239# European Space Data Center, Darmstadt (West Germany).
ORBITAL ANALYSIS, ORBIT DETERMINATION, AND DATA PROCESSING AT THE GODDARD SPACE FLIGHT CENTER
Hans G. Walter Feb. 1965 27 p refs
(SM-1)

The activities of the data systems division of the Goddard Space Flight Center are described. This division, which is responsible for orbital analysis, orbit determination, and data processing, has four subdivisions: coordination, theory, and analysis; advanced orbital programing; computer operations; and data processing and analysis. The first three groups are responsible for studies in connection with orbit determination of satellites, orbit improvement, predictions for tracking and telemetry stations, and ephemerides calculations for experimenters. The data processing group receives satellite positions from the other three groups, reduces raw measurements to physical quantities, and makes theoretical interpretations on them. A detailed study on the functions of the coordination, theory, and analysis group, and the orbital analysis and data reduction performed at the Smithsonian Institution Astrophysical Observatory are included in the appendix. R.N.A.

N65-25247# Library of Congress, Washington, D. C. Aerospace Technology Div.
SCANBACK OF THE SOVIET MANNED SPACEFLIGHT PROGRAM (THE VOSHOD FLIGHTS, FUTURE PLANS, LUNAR AND MARS PROGRAMS), MAY 1964–APRIL 1965
Compilation of Abstracts
20 Apr. 1965 153 p refs
(ATD-P-65-19; AD-463146) CFSTI: HC $5.00/MF $1.00

The Scanback report is designed as a special trial service for users of WA-22 reports. It is based on a selective compilation of previously published SCAN items prepared by analysts of the S and T Section of the Aerospace Technology Division. Selected abstracts have been assembled for reference and review. R.W.H.

N65-25271*# Electro-Optical Systems, Inc., Pasadena, Calif.
ANALYSIS OF ANCILLARY EQUIPMENT FOR SOLAR-THERMIONIC SYSTEM. VOLUME II: TECHNICAL BACKGROUND, SECTION 1 THROUGH 6 Final Report
W. R. Menetrey and J. Neustein 10 Mar. 1965 282 p Prepared for JPL
(Contract NAS7-100)
(NASA-CR-62976; EOS-4326, Final) CFSTI: HC $6.00/MF $1.50

Technical background information for the project is contained in this volume. Major subdivisions of the report are *System Considerations; Solar Concentrators; System Structure and Mechanisms; Thermionic Converter; Thermionic Generator; Instrumentation; Solar Flux Control; Cesium Reservoir Control; Power Conditioning and Control;* and *Recommendations for Development Programs.* E.E.B.

N65-25285# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
A STUDY OF RADAR PROBING OF THE LUNAR SUBSURFACE
D. J. Germignani Oct. 1964 248 p
(RE-186)

The feasibility of exploring the consistency of rock layers beneath the surface of the moon by analyzing reflected microwaves excited by a radar system installed in a lunar orbiting satellite was studied. Presented are results of a study of a simplified model which disposes of variables as the nature of reflected fields due to a narrow pulsed incident field in the vicinity of a stratified or continuous lossy half-space, and the existence of a low conductivity within the lunar subsurface in order to allow penetration of electromagnetic waves for subsurface analysis, without losing the essential features of the problem. S.C.W.

N65-25359# European Space Research Organization, Paris (France).
THE METEORITE ENVIRONMENT OF EARTH SATELLITES
S. L. Entres [1962] 12 p refs
(P/699)

Mathematical expressions for estimating various types of meteorite hazards to earth satellites are presented. To provide a descriptive model for the meteoric environment of earth satellites, a probability distribution is developed which permits estimation of the meteoric mass flux in any arbitrary mass range. Based on laboratory studies of particle penetration into lead targets, an expression is presented for crater formation. It is concluded that impacts of large meteorites that would do gross damage to a satellite are extremely unlikely, whereas small particles in the mass range 10^{-10} to 10^{-9} g hit a unit area with a frequency of more than one particle per second. J.M.D.

N65-25362# Royal Aircraft Establishment, Farnborough (England).
A REVIEW OF ZERO g RESEARCH AT THE ROYAL AIRCRAFT ESTABLISHMENT
J. Porter 3 Sep. 1964 25 p refs Presented at the European Space Res. Organ. Summer School, Oxford, 10 Aug.–3 Sep. 1964
(P/903)

Discussion shows the importance of the zero-g environment of an orbiting satellite as a factor in the design of two phase liquid-vapor systems. Possible methods of zero-g simulation discussed lead to a description of the facilities devised and used at the Royal Aircraft Establishment. To demonstrate application of these facilities a particular design of satellite fuel tank is considered. Author

N65-25365# European Space Technology Center, Delft (Netherlands).
ATTITUDE RECONSTITUTION THROUGH CONICAL HORIZON SCANNING
J. Vandenkerckhove and M. Renard Oct. 1964 44 p
(TN-2)

The possibilities for attitude reconstitution by means of conical horizon scanning are investigated. Horizon scanners are infrared detectors which can discriminate between the radiation temperature of the earth and of the sky, and are allowed to rotate around an axis. Two possibilities are investigated. The first is a spin stabilized satellite with the horizon sensor being fixed to the body, scanning being obtained by taking advantage of the spin and the second is a stabilized satellite with a rotating horizon scanner. Calculations and results for these possibilities are presented. N.E.A.

N65-25398# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
TRANSIENT DYNAMIC RESPONSE OF ORBITING SPACE STATIONS
C. L. Tai, L. V. Andrew, M. M. H. Loh, and P. C. Kamrath Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Feb. 1965 351 p refs
(Contract AF 33(657)-10219)
(FDL-TDR-64-25; AD-613081)

The stability and dynamic response of 13 rotating space station configurations when subjected to various applied disturbances were investigated first by approximate exploratory analyses to determine the significant configurations and the relative significance of transient inputs to each configuration. Detailed analyses of 10 selected combinations of configurations and forcing functions were then carried out in depth with

special attention to internal mass motions, docking, angular acceleration, and control forces. In view of the unique dynamic response problems associated with the gravitational gradient and structural elasticity, separate detailed analysis of the cable-connected configuration, the Y-configuration, and the H-configuration were also conducted. Author

N65-25460# White Sands Missile Range, N. Mex. Data Reduction Div.
CONTRAVES TRAJECTORY DATA FOR NASA AEROBEE 4.122 GG, LAUNCHED 23 AUGUST 1964 Final Data Report
Robert Beckham 14 Sep. 1964 159 p
(Rept.-17729; AD-461065)

A report designed to provide missile position, velocity, acceleration, and trajectory angle data for the Aerobee is presented. Included are unsmoothed position data with error estimates; smoothed position, velocity, and acceleration data; total velocity, tangential acceleration, normal acceleration, and trajectory angle data; error estimates for smoothed position, velocity, and acceleration data; and error estimates for total velocity, tangential acceleration, normal acceleration, and trajectory angle data. Unsmoothed position data were computed using a technique which selects the point so that the sum of the squares of the residual angles, from the observed lines of sight to the point, is a minimum. Error estimates are tabulated following the unsmoothed position data and are not tabulated for interpolated position points. All position data refer to the tail of the missile. S.C.W.

N65-25545# Hungarian Academy of Sciences, Budapest.
PHOTOELECTRIC STUDY OF THE RRc VARIABLE RU PISCIUM
J. Tremko (Slovak Acad. of Sci.) Apr. 1964 41 p refs *Its* Commun. No. 55

In 1961–1964, 4204 photoelectric observations in yellow color were obtained utilizing the 24-inch reflector of the Astronomical Institute of the Slovak Academy of Sciences at Skalnate Pleso. The analysis of the observations shows rapid variations in the primary period and the existence of a secondary period. The $P_0 = 28.8$ days, in the course of which the amplitude of the light curve varies between $0^m.459$ and $0^m.531$.
Author

N65-25548*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
COMPUTATION OF SUB-SATELLITE POINTS FROM ORBITAL ELEMENTS
Richard H. Christ Washington, NASA, Jun. 1965 38 p refs
(NASA-TN-D-2771) CFSTI: HC $2.00/MF $0.50

Presented is the computer program for computing predicted subsatellite points of radiating satellites for launch interference purposes. This method interpolates the orbital elements at the time of interest from the given ephemeris, transforms them to a position factor, and computes the subsatellite points from the position vectors. Output may be used for standard look angle computations. The program is coded in Fortran II language.
G.G.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N65-24474# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Inter-Range Instrumentation Group
METEOROLOGICAL ROCKET NETWORK FIRINGS. VOLUME XXXV: JULY 1964 FIRINGS Data Report
Nov. 1964 264 p
(IRIG-109-62; AD-456993)

Wind and temperature measurements from all available network firings for July 1964 are presented. The radiosonde observations nearest the time of firing are included. The data were derived from a total of 120 rocketsonde observations, and the meteorological rocket network stations which have contributed data are listed. All altitudes are reported in meters and wind speeds in meters per second. An error correction is applied to all rocketsonde temperature data, and smooth connecting curves of the data are presented. The types of rockets and their temperature and wind sensor instrumentation systems are identified on the charts and by code on the corresponding data sheets. R.C.S.

N65-24567*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SA-9, 8, AND 10 DISPERSION ANALYSIS
Gerald Wittenstein and Jerry D. Weiler 17 May 1965 63 p refs
(NASA-TM-X-53263) CFSTI: HC $3.00/MF $0.75

A detailed discussion of dispersions, their philosophy, and application with respect to a nominal trajectory is presented. A brief description of the SA-9 nominal trajectory is contained as a reference. The group of trajectories presented in the dispersion analysis is considered representative and considered to yield a satisfactory envelope for the remaining Block II flight profiles (SA-8 and SA-10). Considering the vehicle $\pm 2\sigma$ perturbations, all mission objectives and requirements will be met with a high level of confidence. Author

N65-24625*# Douglas Aircraft Co., Inc., Santa Monica, Calif.
SPACE TECHNOLOGY. VOLUME I: SPACECRAFT SYSTEMS
L. H. Abraham Washington, NASA, 1965 82 p Prepared for course in Space Technol. given by Calif. Inst. of Technol., 19 Jun.–31 Jul. 1964
(Grant NsG-598)
(NASA-SP-65) GPO: $0.35; CFSTI: MF $0.75

This publication contains notes prepared for a course on the science and technology of spacecraft systems, given by the California Institute of Technology in cooperation with the Jet Propulsion Laboratory. Included are synopses of system and subsystem requirements; sizing and configuration parameters influencing the design of space vehicles; aerodynamic, powerplant and other loads; structural material selection; design of manned space cabins; propellant tank design; common bulkhead derivations, and the tensile paradox. S.C.W.

N65-24720*# General Motors Corp., Santa Barbara, Calif. Aerospace Operations Dept.
EXPERIMENTAL INVESTIGATIONS OF SIMULATED METEOROID DAMAGE TO VARIOUS SPACECRAFT STRUCTURES Progress Report No. 2, Period Ending 30 Nov. 1964
C. J. Maiden, J. W. Gehring, A. R. Mc Millan, and R. E. Sennett 1 Dec. 1964 7 p
(Contract NAS9-3081)
(NASA-CR-65036)

The effects of impulse loading on pretensioned beams were investigated to help establish design criteria and equations

to define the penetration mechanics of meteoroids into typical spacecraft structures. Preliminary results indicate: (1) The maximum displacement of the beams is reduced significantly. (2) The required backup plate thickness under a pretension of 100% of yield stress increases about 6% if the criterion of no yield is imposed, and about 70% if the fracture criterion is used. Experiments to determine the effects of projectile, and shield melting and vaporization were conducted with cadmium projectiles against cadmium shields and produced momentum multiplications of 1.16 and 1.42, respectively, much less than the 2.0 expected. Tests to measure the stress in the wave reaching the back surface of the backup structure with cadmium projectiles and shields by the throwoff pellet technique showed 7.7 kilobars at high velocity, and 22 kilobars at a low velocity. Density effects were detectable at velocities up to 7 km/sec.
G.G.

N65-24721# General Motors Corp., Santa Barbara, Calif. Aerospace Operations Dept.
EXPERIMENTAL INVESTIGATIONS OF SIMULATED METEOROID DAMAGE TO VARIOUS SPACECRAFT STRUCTURES Progress Report No. 1, Period Ending 30 Sep. 1964
C. J. Maiden, J. W. Gehring, A. R. Mc Millan, and R. E. Sennett
1 Oct. 1964 14 p refs
(Contract NAS9-3081)
(NASA-CR-65035) CFSTI: HC $1.00/MF $0.50

A program designed to study the physics of interaction of a meteoroid with a thin metallic shield and the damaging effects of the debris that passes through the shield is reported. The primary objective is the establishment of design criteria and equations to define the penetration mechanics of meteoroids into typical spacecraft structures. Results show that impacts against shielded targets at very high velocities yield very slight penetrations in the backup sheet. The response of the backup structure was calculated using the general numerical procedure for determining the response of structures to blast and impulsive loading. Strip approximations were used to represent the backup sheet, and the centerline displacement and strain at the center and edge of the loaded portion of the strip were determined. Also considered were the effects of spacing, momentum, velocity, and impact. Results of experiments with aluminum projectiles impacting against aluminum shields agreed with predictions made using strip approximation calculations.
S.C.W.

N65-24724*# General Motors Corp., Santa Barbara, Calif. Aerospace Operations Dept.
EXPERIMENTAL INVESTIGATIONS OF SIMULATED METEOROID DAMAGE TO VARIOUS SPACECRAFT STRUCTURES Progress Report No. 4, Period Ending 31 Mar. 1965
C. J. Maiden, J. W. Gehring, A. R. Mc Millan, and R. E. Sennett
1 Apr. 1965 11 p
(Contract NAS9-3081)
(NASA-CR-65038) CFSTI: HC $1.00/MF $0.50

Impact computations over the same range of particle sizes and velocities as the strip approximation were performed for a 1/8-in. aluminum particle and the Apollo particle with the strip and plate approximations. Curves for both figures are presented down to 6 km per second. The results of calculations on the density distribution showed that distribution had only a slight effect on the predicted thicknesses. Preliminary studies of the spall phenomenon impact through the use of a one-dimensional model of the shock wave in the second sheet predicted a spall fracture for a plate of 9.52-mm thickness. Experiments established a fracture about 0.5-mm beneath the rear surface of the backup. Experiments with cadmium projectiles and shields at a velocity of 5.6 km/sec were compared to previously reported aluminum–aluminum distribution momenta and were found to be greater than the aluminum impacts. A safe total thickness was estimated from experimental impacts of an aluminum shield with different backup thicknesses.
G.G.

N65-24766# Rome Univ. (Italy). Aerospace Research Center
THE INFLUENCE OF THE WEIGHT OF THE THERMAL PROTECTORS ON THE PERFORMANCE OF THE MULTI-STAGE ROCKETS [L'INFLUENZA DEL PESO DEGLI SCHERMI TERMICI SULLE PRESTAZIONI DEI RAZZI POLISTADI]
Severino Giorgi Oct. 1964 27 p refs In ITALIAN *Its* Atti No. 7

The determination of the maximum achievement of a rocket probe as a function of the kinetic heating of the nose is presented. The problem is treated in rigorous form and simplified by numerical solution with use of a computer.
Transl. by P.F.E.

N65-24896*# General Electric Co., Philadelphia, Pa. Spacecraft Dept.
VOYAGER SPACECRAFT SYSTEM STUDY. PHASE I: TITAN IIIC LAUNCH VEHICLE. VOLUME I: SUMMARY Final Report
7 Aug. 1964 81 p Prepared for JPL
(Contracts NAS7-100; JPL-950847)
(NASA-CR-62958; Doc.-64SD933) CFSTI: HC $3.00/MF $0.75

Results obtained from a conceptual design study for a Voyager spacecraft to be launched by Titan IIIC are summarized. The objectives were to prepare a conceptual design of a bus/lander and an orbiting spacecraft for Mars 1971 and to estimate the spacecraft performance for Mars 1973, 1975, 1977, Venus 1972, the performance for a combined Orbiter/Lander system, and the cost and development cycle for the Mars 1971 systems. The prior Voyager design study indicated that a combined orbiter/lander system would be inefficient in the weight class (3600 pounds) associated with the Titan IIIC launch vehicle. Maximum utilization was made of a previous study, which assumed a Saturn 1B + SVI launch vehicle, so that the results of the two studies would be on the same basis, permitting a valid evaluation of the Titan IIIC and the Saturn 1B + SVI launch vehicles for the Voyager mission.
R.W.H.

N65-24918 National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board
COMMUNICATIONS SATELLITES
In its U.S. Space Sci. Program, Rept. to COSPAR 1963 p 109-112 (See N65-24908 14-30)

Passive and active communication satellite programs are discussed. Experience with Echo I passive satellite in 1960 indicated the need for larger and more rigid spherical satellites capable of longer life, and for improved techniques for fabricating lighter satellites that are sufficiently rigid. Spheres 41 meters in diameter with a mylar sheet sandwiched between aluminum layers are being constructed to achieve 20 times greater buckling resistance than Echo I. Development of reflective space structures with gain superior to that of spheres is underway. Project Telstar, intended to investigate transmission of wideband signals from active satellites in earth orbit, and the specific objectives of Telstar I, are summarized. Project Relay objectives, and the first low-altitude Relay active satellite for testing solar cell life and measuring environmental radiation, are described. A detailed photograph of the Syncom active satellite is shown.
J.M.D.

N65-24921# Boeing Co., Seattle, Wash.
MARS ORBITER—LONG TERM PREDICTION
S. C. Pilet [1965] 39 p refs
(D2-23862-1)

A digital computer program the determines the behavior of satellite orbits around Mars over long periods of time is described. Disturbing influences that can be considered are the Sun, solar radiation pressure, and the zonal harmonics J_2 and J_3 of the gravitational potential of Mars. Only secular and very long period terms are computed, and those terms whose periods depend on the periods of revolution of the satellite about Mars and of Mars around the Sun are neglected. Equations for the variation of orbital elements and for the effect of radiation pressure are described. User's instructions, a numerical example, a flow diagram, and a program listing are also included. Author

N65-24947# National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
OPERATIONS REQUIREMENT FOR BLACK BRANT ROCKET AA-II-43: COSMIC RAY, LANGMUIR PROBE AND MICROMETEORITE LAUNCH FROM CHURCHILL RESEARCH RANGE CRR Operations Requirement No. 130
A. Staniforth and K. A. Steele Apr. 1964 66 p Revised
(ERB-661)

Black Brant Rocket AA-II-43 was instrumented to measure various phenomena in the upper atmosphere associated with auroral activity. The instrumentation included cosmic ray detectors concerned with the energy spectrum and direction of particles associated with auroral activity. Langmuir probe measurements of the fine structure of electron density and energy spectra, and acoustic-type impact sensors for micrometeorite detection. The rocket is to be directed into a visible auroral display under conditions of darkness, no cloud cover, and no moon. Requirements for working space, transport, power, communications, meteorological, and other technical support at the range are given. It describes briefly the test and the rocket, and gives details of the telemetry used and the data to be recorded. A detailed user countdown is also included. Author

N65-24948# National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
OPERATIONS REQUIREMENT FOR BLACK BRANT ROCKET AA-II-37: COSMIC RAY, LANGMUIR PROBE AND MICROMETEORITE LAUNCH Operations Requirement No. 144
F. V. Cairns 15 Jun. 1964 74 p
(ERB-676)

Described are the complete operations requirements for the launch and flight of the Black Brant IIA rocket which will carry several experiments in its nose cone for investigations of the upper atmosphere. The desirable conditions at launching are (1) visual or radar indication of aurora; (2) auroral absorption; and (3) darkness, with no cloud cover and no moon. Tests to be performed include the switching of the multiplex relays at T + 30 seconds, and the extension of the Langmuir probes at T + 60 seconds. Range personnel will control the nose cone instrumentation during the rocket flight, and will monitor the equipment for outputs from the discriminators of the 219.5 Mc link. G.G.

N65-24949# National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
OPERATIONS REQUIREMENTS FOR BLACK BRANT ROCKET AD-II-58: FALLING PROBE ELECTRON DENSITY, ELECTRIC FIELD PROBE, LANGMUIR PROBE AND MICROMETEORITE LAUNCH Operations Requirement No. 145
F. V. Cairns 15 Jun. 1964 78 p
(ERB-677)

Continued research is reported on the Black Brant rocket designed for (1) measuring electron density detail structure within an auroral formation by a radio frequency impedance probe method; (2) measuring electric field potential profile using an ejected package carrying its own transmitter; (3) plasma probe measurements of fine structure of electron density and electron energy spectrum inside and outside auroral formations; and (4) measuring impact rates and energy distribution inside and outside major meteor showers in association with auroral activity. Discussed are general and specific operations requirements. Included are data on engineering photography, telemetry, and other data-gathering systems; meteorological services; support instrumentation; material and services; transportation logistics; recovery; data processing and disposition; aircraft and seacraft; facilities; and range safety. S.C.W.

N65-24979*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR PROJECT STATUS REPORT AS OF 14 MAY 1965
L. S. Frankenstein 20 May 1965 54 p
(Contract NAS7-100)
(NASA-CR-63124) CFSTI: HC $3.00/MF $0.50

Progress is reported on the Surveyor project and includes activity schedules for the flight and ground based test programs, mission operations systems and mission peculiar equipment testing, spacecraft testing and operations planning for the various flight missions, test model and prototype vehicle development, terminal descent and vernier propulsion subsystem testing, thermal control model tests, and PERT network survey. R.N.A.

N65-25232*# National Aeronautics and Space Administration, Washington, D. C.
ORBITING GEOPHYSICAL OBSERVATORY
[1965] 1 p
(NASA Facts Vol. II, No. 13) GPO: $0.15

The OGO (Orbiting Geophysical Observatory) 1 carries 20 different experiments as compared to the 8 experiments of Explorer XVIII. The principal advantage of OGO is that it makes observations of numerous phenomena simultaneously for extended periods of time. The EGO (Eccentric Geophysical Observatory) traverses the earth's space environment and flies beyond it into interplanetary space. The EGO studies the sun, the intense Van Allen Radiation Region that surrounds the earth, and the electrons and protons constituting the solar winds that rush constantly from the sun's turbulent surface. The POGO's (Polar Orbiting Geophysical Observatory) primary goal is to increase knowledge about how fluctuations in solar activity affect the characteristics of earth's atmosphere, ionosphere, and magnetic field. As the earth and OGO revolve around the sun, the solar paddles will require repositioning. By turning the paddles properly every 2 months, OGO engineers can maintain an adequate power supply for the spacecraft. R.W.H.

N65-25441# New Mexico State Univ., University Park. Physical Science Lab.
FIXED CAMERA TRAJECTORY DATA, NASA AEROBEE 4.122 GG, LAUNCHED 28 AUGUST 1964 Final Data Report
9 Sep. 1964 23 p
(Contract DA-29-040-ORD-2060)
(Rept.-17-372; AD-461070)

The Aerobee was launched from launcher position L-21 on August 28, 1964 at $22^h30^m0.604^s$ MST. The missile position, velocity, trajectory, and acceleration as obtained from camera reduction data are presented. Trajectory data were obtained from three stations. Position data were obtained by using the technique which computes a position point such that the sum of the squares of the residual angles, from the observed lines of sight to the point, is a minimum. E.E.B.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N65-24441# Bureau of Mines, Bruceton, Pa. Health and Safety Research and Testing Center
USE OF POLYESTER-TYPE RESIN TO STABILIZE FRACTURED ROCK Progress Report
Richard H. Oitto, Jr. 1965 20 p refs
(BM-RI-6626)

A polyester-type resin and deformed-steel reinforcing bars (rebars) were used in combination to strengthen and stabilize bolted, fractured wall rock along passageways in a western gold mine. Reinforcing bars were placed in boreholes drilled into fractured rock, and then were surrounded by resin pumped under pressure into the holes and intersecting fractures until the wall rock was thoroughly impregnated. Pumping and injection equipment and infusion procedures are described. Visual examinations for movement in bonded and adjacent unbonded rock were made for 3 years. Fractured walls containing resin-rebar installations were strengthened. The results suggest that resin-rebar support can be used advantageously and economically in repairing fractured or broken rock when compared with rock bolting or timbering. Author

N65-24613# Pisa Univ. (Italy). Inst. of Applied Mechanics
VIBRATIONAL PROPERTIES OF THE RIGID COVERS [VIBRAZIONI PROPRIE DEGLI INUOLUCRI IRRIGIDITI]
Giorgio Bartolozzi Jun. 1964 25 p refs In ITALIAN *Its* 22d Ser., No. 1057

Relative vibrational frequencies for rigid cylindrical thin shells were calculated for symmetric and antisymmetric modes of torsional and bending deformation. Transl. by P.F.E.

N65-24645# Pisa Univ. (Italy). Inst. of Applied Mechanics
PROGRESS AND CONSTRUCTION OF A LOADING DEVICE FOR FATIGUE TESTING PARTS [PROGETTO E COSTRUZIONE DI UN DISPOSITIVO DI CARICO AD ELEMENTI COMPONIBILI PER PROVE DI FATICA]
Giorgio Bartolozzi Jun. 1964 14 p In ITALIAN *Its* 22d Ser., No. 1056

Progress and construction is reported on a loading device which is used for fatigue testing at the University of Pisa. Transl. by P.F.E.

N65-24646# Pisa Univ. (Italy). Inst. of Applied Mechanics
CONNECTING FORCED HUB SHAFTS STRAINED BY FATIGUE [ACCOPPIAMENTI FORZATI ALBERO-MOZZO SOLLECITATI A FATICA]
Giorgio Bartolozzi Jun. 1964 16 p refs In ITALIAN *Its* 22d Ser., No. 1058

Fatigue testing of C-40 steel hub shaft assembly after heat treatment is considered. Transl. by P.F.E.

N65-24647# Pisa Univ. (Italy). Inst. of Applied Mechanics and Aeronautics
OPTIMAL PERFORMANCE CONTROL SYSTEMS [SISTEMI DI CONTROLLO A COMPORTAMENTO OTTIMO]
Giovan Gualberto Lisini 1964 32 p refs In ITALIAN *Its* 22d Ser., No. 1062

The fundamentals of the theory of optimal control and the difficulties encountered in practical applications are given. Transl. by P.F.E.

N65-24656*# Whirlpool Corp., St. Joseph, Mich. Systems Div.
DEVELOPMENT OF FLEXIBLE FOAMED FILLED STRUCTURES, PHASE I Progress Report, 18 Sep.–18 Dec. 1963
K. Telford Marshall [1964] 33 p
(Contract NAS9-2031)
(NASA-CR-59832) CFSTI: HC $2.00/MF $0.50

A suitable urethane foam formulation was developed to meet requirements for storage life and foaming the life raft. A static head for mixing this particular formulation was developed, tested, and incorporated in the schematic drawing of the proposed portable, static foam machine. A design was developed that incorporates an inner CO_2 gas chamber with an outer concentric tube for foaming in place and the two tubes spaced in position with narrow tapes of the raft material. A prototype of this design was fabricated and foamed in place. Buoyancy of the raft was tried in the inflated condition and the foamed condition. Author

N65-24759# Royal Inst. of Tech., Stockholm (Sweden).
A MACHINE FOR CREEP TESTS WITH COMBINED TENSION AND TORSION [EN MASKIN FOR KRYPPROV VID SAMTIDIG DRAGNING OCH VRIDNING]
Ragner Lundell 1964 39 p refs In SWEDISH; ENGLISH summary
(Publ.-148)

A machine was built for creep tests on tubular specimens under combined tension and torsion. Tensile force in applied by a hydraulic jack and the torque by dead weights and a system of pulleys and wire ropes. A universal joint is used to reduce bending moments and a spherical roller bearing to minimize friction. Elongation and angle of twist of the test specimen are measured by differential transformers and recorded on a potentiometer recorder. A servosystem was constructed to give a constant rate of elongation of the specimen, and the tensile force is measured and recorded. The machine contains a furnace with four windings which can be controlled separately for even temperature distribution along the specimen, and a regulator to keep temperature constant during tests. Preliminary creep tests showed the machine performs satisfactorily. Author

N65-24765# Rome Univ. (Italy). Aerospace Research Center
CONTRIBUTION TO THE STUDY OF THE FLAT PLATE [CONTRIBUTO ALLO STUDIO DELLA LASTRA-PIASTRA]
Giuliano Quozzo Sep. 1964 34 p refs In ITALIAN; ENGLISH summary *Its* Atti No. 6

This work deals with the study of a rectangular panel having flexural and extensional rigidity, fixed edges, under a load

distributed over its surface. The deflections expression is determined by energy methods and also by equilibrium equations. Author

N65-24767# Rome Univ. (Italy). Aerospace Research Center
STRUCTURAL DYNAMICS OF SPINNING SYSTEMS [DINAMICA STRUTTURALE DEI SISTEMI ROTANTI]
Giorgio Ravelli Nov. 1964 29 p refs In ITALIAN; ENGLISH summary *Its* Atti No. 8

Structural dynamic response of an elastic spinning body to an external force was analyzed. Resonance and coupling phenomena between the motions along three reference axes are pointed out. Author

N65-24798# Midwest Research Inst., Kansas City, Mo.
RESEARCH ON PANEL FLUTTER Final Technical Report
Ronald O. Stearman Dec. 1964 42 p refs
(Contract AF 49(638)-1324)
(AFOSR-65-0247; AD-614801)

The basic objective is concerned with the influence of an external flow field on the stability characteristics of thin cylindrical shells. The significant accomplishments attained include the design and fabrication of a cylindrical shell flutter model, its supporting instrumentation, and a thin shell electroforming facility for fabricating the flutter shells. These combined accomplishments will permit a first correlation of experimental shell stability studies at the lower supersonic Mach numbers. Author

N65-24817# Rocketdyne, Canoga Park, Calif.
THREE DIMENSIONAL AND SHELL THEORY ANALYSIS FOR AXISYMMETRIC VIBRATION OF ORTHOTROPIC CYLINDERS
I. Mirsky 1 Mar. 1965 39 p refs
(Contract DA-31-124-ARO(D)-250)
(R-6096; AROD-4726-1; AD-459477)

The problem of axisymmetric vibration of orthotropic cylinders based on the three-dimensional equations of elasticity is considered. Solutions to these equations are obtained in closed form by an application of the Frobenius power series method. In addition, asymptotic solutions are developed for the high frequency range. Numerical results of frequency versus wavelength are presented for the crystals, barite and topaz, and are compared with those obtained from an approximate shell theory developed previously by the author. Author

N65-24845*# General Motors Corp., Santa Barbara, Calif. GM Defense Research Labs.
STRUCTURES I: THE RESPONSE OF BEAMS AND RINGS TO HIGH-INTENSITY, SHORT-DURATION LOADING
R. E. Sennett and D. E. Skaar Feb. 1965 44 p refs
(Contract NAS9-3081)
(NASA-CR-65039; TR65-08) CFSTI: HC $2.00/MF $0.50

Computer programs are given for determining the response of beams and rings to impulsive loads, with their use described in detail. Two sample problems illustrate the input and output data formats, as well as various output options. Author

N65-25011*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A BIBLIOGRAPHY CONCERNING ASPECTS OF THE METEOROID HAZARD
John B. Gayle, Charles C. Dalton, Henry L. Martin, William D. Murphree, and Charlotte F. Shenk 1 Apr. 1963 288 p refs
(NASA-TM-X-56505; MDWG-63-2) CFSTI: HC $6.00/MF $1.50

A bibliography of 876 annotated studies on the physics of hypervelocity impact and the meteoroid hazard is presented. Discussed are: *Surveys of Experimental Data; Vehicle Protection Analysis; Theoretical Studies on Hypervelocity Impact; Experimental Investigations; Experiments and Instrumentation; and Theoretical Studies on Meteoritics.* The entries were obtained from a variety of sources, and the author, title, agency, periodical, and ASTIA numbers are included. G.G.

N65-25124# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
A NUMERICAL METHOD FOR THE ANALYSIS OF GEOMETRICALLY NONLINEAR ELASTIC STRUCTURES
G. Isakson Dec. 1964 48 p refs
(RM-258)

A numerical method for the finite-deflection analysis of elastic structures is outlined. It is based on an incremental application of the loading and utilizes a procedure resembling that of the predictor–corrector methods in the numerical solution of ordinary differential equations in conjunction with standard matrix methods of linear structural analysis. Its principal advantage over existing methods is in its avoidance of the repeated inversion of matrices. Application is made to simple cases for which exact solutions are available. The procedure is found to be unstable in some situations. A device is introduced which extends the stable loading range very substantially. The solution in the stable range is found to be highly accurate in the cases treated. Author

N65-25213# National Aeronautical Lab., Bangalore (India).
A STUDY OF SIMPLY SUPPORTED SQUARE PLATES WITH CUTOUTS BY THE MOIRE METHOD AND BY FINITE DIFFERENCES
B. Basava Raju Dec. 1964 34 p refs
(TN-SA-5-64)

The moments and deflections in the case of uniformly loaded, simply supported square plates are found by the Moire method. The variation of deflections and moments due to cutouts are also studied by this method. As a check for experimental method, finite difference analysis is presented. The Moire method for a simply supported and uniformly loaded square plate gives a solution which is 5 to 12 percent smaller than the solution by finite differences, and the solution given by Levy. The effect of cutout in a uniformly loaded, simply supported square plate extends to a distance from the cutout slightly greater than the size of the cutout. The size of the cutout has little effect on maximum moment and deflection unless the cutout size exceeds a quarter of the plate span. Author

N65-25274*# Douglas Aircraft Co., Inc., Santa Monica, Calif.
SOME CONSIDERATIONS IN THE FATIGUE DESIGN OF LAUNCH AND SPACECRAFT STRUCTURES
R. H. Christensen and R. J. Bellinfante Washington, NASA, Jun. 1965 112 p refs
(Contract NAS7-298)
(NASA-CR-242) CFSTI: HC $2.00/MF $0.75

Five years ago, metal fatigue was considered by many to be an unimportant problem in the design of space vehicle systems. Within this period, potential problems were reviewed periodically as experience in the operation of these vehicles increased. No fatigue design criteria have yet been formally

documented for this new class of vehicles. Now, trends in future space system design, in addition to some current experience, dictate that the problem can no longer be neglected. This report is intended to supply background information useful in the design of space vehicle system structures. The report presents a definition of the fatigue problem as it relates to the strength of structure. It briefly reviews present knowledge in designing to prevent the occurrence of this undesirable phenomenon. Current evaluation methods and guides for use in design, test, and analysis are also reviewed. Several appendixes appear at the end of the report. Their purpose is to serve as a checklist for the designer on those aspects of the problem that are often neglected or are not well known. A review of the appendixes will also reveal those areas in which additional research is required. Author

N65-25327# Bendix Corp., Ann Arbor, Mich. Systems Div.
THE CANADIAN ARMAMENT RESEARCH AND DEVELOPMENT ESTABLISHMENT (CARDE) SUPPORT PROGRAM Final Report, 1 Jan. 1960–31 Dec. 1964
J. Rutkowski and A. Kresse [1965] 96 p refs
(Contract DA-20-018-ORD-23307; ARPA Order 133-64; Proj. Defender)
(BSR-1109; AD-459047)

A brief synopsis of previous activities are documented. A facility review is presented covering the status of the ballistic ranges as of 1961, as well as their subsequent evolution. A technical summary and bibliography of the salient features of individual research efforts are given. Author

N65-25350# Royal Aircraft Establishment, Bedford (England).
VERTICAL ACCELERATIONS DUE TO STRUCTURAL VIBRATIONS OF A SLENDER AIRCRAFT FLYING IN CONTINUOUS TURBULENCE
J. K. Zbrozek London, Min. of Aviation, Jul. 1963 55 p refs
(RAE-TN-AERO-2901)

A numerical study is made of the vertical accelerations due to structural vibrations of a slender aircraft flown in continuous turbulence. The basic aircraft configuration considered is that used in previous aeroelastic studies, but the analysis is extended to cover the effects of aircraft size, airframe stiffness, wing loading, lift slope and speed and altitude of flight. Only the first structural mode is studied in some detail, but the order of the effects of the rigid body mode and higher structural modes are investigated also. It is concluded, that for a configuration approximating to a future supersonic transport design, the vertical vibrations should be quite acceptable for passengers but, in some conditions may impair crew efficiency. Author

N65-25372*# General Motors Corp., Santa Barbara, Calif. Defense Research Labs.
EXPERIMENTAL INVESTIGATIONS OF SIMULATED METEOROID DAMAGE TO VARIOUS SPACECRAFT STRUCTURES Progress Report No. 3, Period Ending 31 Jan. 1965
C. J. Maiden, J. W. Gehring, A. R. Mc Millan, and R. E. Sennett 1 Feb. 1965 6 p
(Contract NAS9-3081)
(NASA-CR-65037) CFSTI: HC $1.00/MF $0.50

The establishment of design criteria and equations to define the penetration mechanics of meteoroids into typical spacecraft structures is investigated. The computer program describing the response of a circular plate to an axially symmetric impulsive load was completed and debugged. Experiments were performed to further define the behavior of the momentum multiplication factor, MV/mv, as a function of impact velocity, shield thickness, spacing and projectile properties. Using cadmium for projectiles and shields allowed the attainment of the debris through the shield in the form of solid, liquid, or vapor. The momentum multiplication factor is dependent upon the state of the debris and the amount of cratering that takes place in the backup sheet. Experiments to examine the effects of projectile porosity and to determine momentum distribution on the backup are continuing. R.W.H.

N65-25377# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
BUCKLING CHARACTERISTICS OF CORRUGATED CYLINDERS–EFFECT OF USING A HIGH STRENGTH MATERIAL
Burton S. Parker May 1964 23 p refs
(AMRA-TR-64-14; AD-603626) CFSTI: $0.50

The results of a supplement to an investigation to study the buckling characteristics of corrugated cylinders are described. The effect of using a high strength material is evaluated. Twenty-five models of varying height, fabricated from 7075-T6 aluminum, were tested under axial compressive loads for instability. The buckling of corrugated cylinders is treated from the viewpoint of the buckling of individual corrugation elements. For slenderness ratios of these elements greater than 110, the buckling data correlate satisfactorily with the Euler column theory. For slenderness ratios below 82, the critical stress is much lower than that predicted by any of the column theories, and is approximated closest by the elastic plate buckling criterion which serves as an upper limit. Author

N65-25379# Naval Research Lab., Washington, D. C. Mechanics Div.
BACKGROUND FOR MECHANICAL SHOCK DESIGN OF SHIPS SYSTEMS Interim Report
G. J. O'Hara 12 Mar. 1965 21 p refs
(NRL-6267; AD-612734) CFSTI: HC $0.75

Some of the progress made since World War II in the several areas related to the complex set of problems encountered in shock design and analysis of shipboard systems is described. Discussed are requirements for shock protection, selection of failure criteria, determination of shock environment, development of analysis and design procedures, results from past research and engineering, and the needs for future research and engineering. The evolution is outlined, from the simple shock design number concept, which is limited to a more rational approach, which can allow the shock design-analysis of unprecedented equipment. Author

N65-25382# Harry Diamond Labs., Washington, D. C.
TRANSITION OF RADIAL AND AXIAL MODES IN VIBRATING CYLINDERS
George K. Lucey, Jr. 15 Jan. 1965 19 p refs
(HDL-TR-1270; AD-613021)

Two equations to determine resonant frequencies, one for thick disks, and one for thick rods, were derived in TR-1108, Resonant Frequencies of Cylinders of Any Dimensions. The dimension ratios of cylinders to which each equation is applicable are defined. The two equations are modified by expressing an empirical constant in terms of material properties. The validity of these new equations is demonstrated by applying them to the published data of Shaw, Bechmann, and McMahon. Author

N65-25387# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics
TORSIONAL WAVES IN COMPOSITE RODS

Anthony E. Armenakas Jan. 1965 33 p refs
(Contract Nonr-839(17)(FBM))
(PIBAL-699; AD-612778)

The propagation of torsional waves in composite, infinitely long, traction-free, circular, cylindrical rods is investigated on the basis of the three-dimensional linear theory of elasticity. The composite rods consist of an internal circular rod made of one material, bounded by and bonded to a circular casing made of another material. The effect of the variation of the geometric and physical parameters on the frequency of the torsional motion is discussed. It is shown that for composite rods, in general, the first torsional mode (no nodes along the radius) may not exist uncoupled. Author

N65-25418# California Univ., Berkeley. Inst. of Engineering Research
MEASUREMENTS OF HEAVE FORCES AND PITCH MOMENTS ACTING ON A RESTRAINED SHIPLIKE MODEL IN REGULAR WAVES
Hou-wen Huang Dec. 1964 43 p refs
(Contract Nonr-222(93))
(NA-64-11; AD-461334)

A fully restrained shiplike model was towed in regular waves to measure the exciting forces and moments acting on it. Results are obtained by integrating the pressure measured over the wetted surface and compared with the theoretical values computed according to the classical Froude–Krylov Theory. The total heave forces and the pitch moments are also obtained by direct force measurement to check the results obtained by pressure integration. Author

N65-25434# Liege Univ. (Belgium).
UPPER AND LOWER BOUNDS IN MATRIX ANALYSIS OF PLATES IN BENDING
G. Sander Nov. 1964 24 p refs
(SA-2)

The method of upper and lower bounds is used to build either a stiffness matrix or a fluxible matrix for analysis of plates in bending. The first case assumes a stress field satisfying the inner and outer equilibrium equations and transmitting continuously the stresses to the next element, thus representing an equilibrium field that will give upper bonds for the displacement. The second case assumes that the strain state of the element is described by a displacement field satisfying inner and outer compatibility conditions and transmitting the strains to the next element, thus representing an entire compatible field and the lower bounds for the displacement. Both approaches were applied to the problem of a square plate with a built-in edge, and produced only a very small gap between results. For the problem of a simply supported square plate loaded in its center, a larger gap was found between the two results, probably because of the greater difference between the boundary conditions applied to both models. G.G.

N65-25468 Laboratorium für Betriebsfestigkeit, Darmstadt (West Germany).
REVIEW OF INVESTIGATIONS ON AERONAUTICAL FATIGUE IN THE FEDERAL REPUBLIC OF GERMANY, APRIL 1963–APRIL 1965
E. Gassner Fraunhofer-Ges. zur Förder. der Angew. Forsch. E. V. [1965] 110 p refs Presented at the Intern. Comm. on Aeron. Fatigue Conf., Munich, Jun. 1965
(LBF-S-55)

Studies on aeronautical fatigue are reviewed and include empennage load measurements on aircraft; crack propagation and residual static strength of an Al–Zn–Mg–Cu alloy; design stress and fatigue life assessments; fatigue tests on a wing–fuselage attachment; stress spectra comparison with fatigue life; loading sequence influence on fatigue life; fatigue tests with alloys under supersonic flight conditions; fatigue tests on an aluminum alloy coated with a synthetic resin; cold working and temperature effect on mechanical damping and fatigue strength of unalloyed titanium; fatigue load effect on titanium weld strength; thread cutting and mean stress effect on Ti–Al studs fatigue strength; cold reduction, rolling scale, and diametral hole effect on titanium sheet fatigue strength; constant load and increasing load comparison in determining steel fatigue limit; fatigue in slotted flat plates under axial constant and variable load amplitudes; and fatigue life of titanium bolted joints. R.N.A.

N65-25471# Martin Co., Baltimore, Md. Nuclear Div.
SNAP-19 SUPPORT STRUCTURE DESIGN DEVELOPMENT AND QUALIFICATION TESTS
W. R. Britton et al Jan. 1965 63 p
(Contract AT(30-1)-3169)
(MND-3169-52)

Development tests conducted on the SNAP 19 Support Structure Assembly are described. Included are descriptions of test procedures, test results, and comparison with the dynamic analysis. Tests were performed on two full-scale support structures with dummy generators simulating the weight and centers of gravity of operational thermoelectric generators. Author

N65-25542# Boeing Co., Renton, Wash. Airplane Div.
FATIGUE CRACK GROWTH, HISTORY OF PROGRAM—LOADED 7178-T6
Harold R. Zahn and Dave Austin 3 May 1965 27 p refs
(D6-2197)

Combining the capabilities of the optical microscope and the electron microscope provides a method for determining the crack growth history of a programed fatigue test. This method works on the basis of obtaining the average striation spacing along the length of the crack and manually integrating. The measurements are made using optical microscopic devices and diagnosing the pattern of striations with the electron microscope. Crack length versus life curves are shown for 3 cracks found in the KC-135 major fatigue test article. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N65-24411# Naval Ordnance Lab., White Oak, Md. Physical Chemistry Div.
ON EQUATIONS OF STATE IN SHOCK INITIATION PROBLEMS
Julius W. Enig and Francis J. Petrone May 1965 14 p refs
(NOLTR-64-182; AD-613989)

The past use of thermodynamically incompatible equations-of-state is investigated. In particular, the previous use of the Mie–Grüneisen equation-of-state in shock initiation problems

for liquid explosives is analyzed. More careful analysis shows that theoretical calculations using this equation-of-state are not in satisfactory agreement with the experimental results. Author

N65-24561*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland.
EXPERIMENTAL PRESSURE-DROP INVESTIGATION OF NONWETTING, CONDENSING FLOW OF MERCURY VAPOR IN A CONSTANT-DIAMETER TUBE IN 1-G AND ZERO-GRAVITY ENVIRONMENTS
James A. Albers and Robert P. Macosko Washington, NASA, Jun. 1965 34 p refs
(NASA-TN-D-2838) CFSTI: HC $2.00/MF $0.50

Local and overall pressure-drop data were obtained for a horizontal, constant-diameter, stainless-steel tube for various flow rates, pressures, and condensing lengths. Measured overall static pressure drop indicated little difference between 1-g and zero-gravity pressure losses at flow rates of approximately 0.028 and 0.046 pound mass per second. Overall static pressure drop varied from 0.20 to 2.24 pounds per square inch, while the total pressure loss varied from 1.4 to 5.4 pounds per square inch for condensing lengths and flow rates considered. The Lockhart–Martinelli correlation predicts Φ_g, within ±30% and, $(\Delta P/\Delta L)_{TPF}$ within ±70% for the high velocity, high quality region of the condensing tube. Pressure gradients both for 1 g and zero gravity are greater than predicted by Lockhart–Martinelli for the low quality region of the tube. Generally, the data trend correlates with the fog-flow theory. Data indicate that the fog-flow parameter approaches 1 for high values of the Weber number. Data spread is least in the high-velocity (high-Weber-number) region of the tube that approaches the fog-flow regime. For the preceding local plots, the effect of gravity was negligible. Author

N65-24564*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
BIBLIOGRAPHY ON THERMAL METALLIC CONTACT CONDUCTANCE
Harry Atkins 15 Apr. 1965 26 p refs
(NASA-TM-X-53227) CFSTI: HC $2.00/MF $0.50

In the area of heat transfer in structures, problems of heat transfer between connected members is complicated by many parameters. An attempt was made to collect all known references on this subject. This report contains references in the area of contact heat transfer measurements and theories and contact surface parameter studies. Author

N65-24580# Aberdeen Proving Ground, Md. Exterior Ballistics Lab.
VAPORIZATION WAVES AS A GENERAL PROPERTY OF HIGH TEMPERATURE MATTER
F. D. Bennett Jan. 1965 13 p refs
(BRL-1272; AD-463128)

Electrical data on exploding wires suggest strongly that vaporization waves can occur in all metals. If a vapor pressure function capable of representing the data for metals is assumed, the thermodynamic, vaporization wave velocity can be expressed in terms of a general function and a characteristic velocity. Values of this velocity calculated for several metals show a spread of four orders of magnitude. Necessary conditions are proposed under which any substance can exhibit vaporization at high temperatures. Author

N65-24588# Naval Ordnance Lab., White Oak, Md. Mathematics Dept.
ALTERNATING DIRECTION SCHEMES FOR THE HEAT EQUATION IN A GENERAL DOMAIN
Bert Hubbard May 1965 28 p refs
(NOLTR-65-27; M-57; AD-462232)

A series of alternating direction schemes for the heat equation in a cylinder are proposed. Asymptotic error estimates are obtained in maximum norm. Author

N65-24602# Northrop Corp., Anaheim, Calif. Space Labs.
THERMAL TRANSPORT SYSTEM FOR A SPACE WORKER'S GARMENT
J. Donald Bowen and Robert F. Witte Wright-Patterson AFB, Ohio, AMRL, Aug. 1963 12 p
(Contract AF 33(657)-8318)
(AMRL-Memo-M-49; AD-224323) (Declassified)

Tests were conducted to evaluate the feasibility of a heat exchanger system and a thermal transport garment system using water as a liquid coolant. The tests were conducted with subjects wearing the thermal transport system (1) with no cover garment, (2) with insulated coveralls, and (3) with the experimental pressure suit and the insulated coveralls. The heat exchanger garment was also placed on an electrically heated copper manikin, covered with the insulated coverall, and then operated to determine its ability to remove heat. In all phases of the program the cooling proved quite adequate. The thermal transport system has shown good potential of solving the problem of heat transportation from a pressure-suited man. Increased efficiency is needed, particularly to obtain a greater temperature rise in the cooling water and thereby reduce the flow required and/or allow warmer water to be used. New concepts of garment heat exchangers should be evolved and evaluated. N.E.A.

N65-24606*# Purdue Univ., Lafayette, Ind. School of Aeronautics, Astronautics, and Engineering Sciences
THERMODYNAMIC FORMULATION OF FINITE LINEAR VISCOELASTICITY FOR ANISOTROPIC MEDIA
Paul H. De Hoff, Jr. and George Lianis Feb. 1965 33 p refs
(Grant NSF GP-2677)
(A&ES-65-3)

The theory of irreversible thermodynamics of continuous media with fading memory is used to formulate general constitutive equations of finite linear viscoelasticity. Specific forms for transversely isotropic and orthotropic media based on both the mechanical and thermodynamic theories are found. Author

N65-24637# Engineering Inst. of Canada, Montreal (Quebec).
THERMAL CONTACT RESISTANCE
T. W. Mc Donald (Univ. of Saskatchewan) Jul. 1963 26 p refs *In* Trans. of the Eng. Inst. of Canada, v. 6, no. B-12
(EIC-63-MECH-12)

The thermal contact resistance magnitude of joints was investigated to determine the effect of type and degree of surface finish, and the thermal properties of the solids in contact as well as the thermal properties of the surrounding fluid. Pressure tests between 5 and 15 psi with steel specimens of four different roughnesses had little effect on the resistance except for the roughest specimen tested. Plots of contact resistance of steel and of aluminum specimens showed that a good correlation was achieved when plotted against the sum of the centerline average roughness readings, and that the resistance varied in a linear manner with the roughness readings

except for very smooth specimens. Any severe waviness or out-of-flatness of the contact surfaces will drastically reduce the conductivity of the joint below the predicted values. G.G.

N65-24755# Lehigh Univ., Bethlehem, Pa.
TRANSIENT THERMAL STRESSES IN AN INFINITE WEDGE
R. A. Lucas and F. Erdogan [1964] 42 p refs
(Grant NSF GP-3200)

The plane transient thermoelastic problem for an infinite wedge subjected to an instantaneous heat source at an arbitrary location is considered. The problem is formulated in terms of displacements, and Mellin–Laplace transforms are used for the solution. A real integral representation of the stress field is given. The main emphasis is placed on the analysis of the singular behavior of stresses around the apex for large values of the wedge angle, 2β. It is found that in the symmetric case for $\beta > \pi/2$ and in the antisymmetric case for $\beta > 0.715\pi$ the apex is a point of singularity for the stresses. The power of this singularity, as well as the variation of the stresses in θ and that of the stress intensity factor in time, is studied and some numerical results are given. Author

N65-24792 Marquardt Corp., Van Nuys, Calif.
TRANSPIRATION-FILM COOLING STUDY USING SPIRAL-WOUND RIBBON NOZZLE First Quarterly Report, 9 Nov. 1964–31 Jan. 1965
J. E. Ahern, A. R. Nagy, Jr., G. A. Yankura, and D. R. Ayres Feb. 1965 65 p refs
(Contract AF 04(611)-10387)
(Rept.-25156; AD-611801)

The program consists of an analytical and experimental evaluation of the cooling capability of a nozzle design made by the spiral-wound-nozzle method. The analytical study was essentially completed and equations for the performance study were selected or developed. Sections of the digital computer program were completed and are being checked out. A simple electrical analog has been built for checking out the computer program. Initial trials of diffusion welding and diffusion bonding of aluminum, copper, stainless steel, and tantalum indicated promising results for bonding of the structure without blockage of the coolant passages. Laboratory bench test apparatus was completed and the initial shakedown test run completed satisfactorily. Evaluation of instrumentation techniques is in progress. Author

N65-24794# ManLabs, Inc., Cambridge, Mass.
THERMODYNAMICS OF MARTENSITIC F.C.C. ⇄ B.C.C. AND F.C.C. ⇄ H.C.P. TRANSFORMATIONS IN THE IRON-RUTHENIUM SYSTEM
Larry Kaufman Mar. 1965 refs Presented at the Conf. on Phys. Met. of Martensite and Bainite, Scarborough, England, 10–12 May 1965
(Contract Nonr-2600(00))
(TR-9; AD-614009)

A thermodynamic analysis of the iron-ruthenium system was performed on the basis of the regular solution model by approximating the lattice stability of hcp, fcc, and bcc ruthenium as being similar to nonmagnetic iron. The analysis permits calculation of the entire phase diagram, the T_0-x curves for diffusionless fcc ⇄ bcc and fcc ⇄ hcp reactions at one atmosphere and the compositional dependence of the fcc/bcc/hcp pressure-temperature triple points, all of which compare reasonably well with observation. The driving force for the martensitic fcc ⇄ bcc reaction is temperature dependent and similar to that observed for iron–nickel alloys. The driving force for the martensitic fcc ⇄ hcp reaction is about 50 cal/mole and, as expected from crystallographic considerations, is smaller than the corresponding fcc ⇄ bcc driving force. Author

N65-24824# Aberdeen Proving Ground, Md. Ballistic Research Labs.
HIGH TEMPERATURE CORES IN EXPLODING WIRES
F. D. Bennett Jan. 1965 11 p refs
(BRL-1270; AD-463252)

Studies show that the precipitous rise in resistance during the initial expansion of the wire occurs because of a radially symmetrical, inward traveling, vaporization wave which transforms the wire to a nonconducting gas. Presence of the inward traveling vaporization wave implies longer heating of the wire interior and a temperature rise with decreasing radius. An approximate theory of the expansion is given which allows estimates to be made of the core temperatures achievable by varying the wire and circuit parameters. The experimental production of high-temperature cores is limited at present by the occurrence of voltage breakdown at the interface between wire and ambient atmosphere. Author

N65-24846*# Emerson Electric Co., St. Louis, Mo. Electronics and Space Div.
PERFORMANCE EVALUATION OF "THERMO-LAG" MATERIAL FOR ENTRY HEAT PROTECTION OF ADVANCED MANNED SPACECRAFT. VOL. I: SUMMARY OF INVESTIGATIONS Final Report, 1 Oct. 1962–31 Jan. 1964
28 Feb. 1964 25 p *Its* Rept.-1675, Vol. I
(Contract NAS9-877)
(NASA-CR-65015) CFSTI: HC $1.00/MF $0.50

The performance and test results of materials for manned entry vehicle heat shields are described. Thermal, thermal–chemical, environmental, and ablation characteristics were evaluated from air arc plasma flight simulation test results. Ablation information was used to develop a computer program for predicting thermal barrier requirements. Structural properties over a range of temperatures and stress performance of a honeycombed heat shield were investigated. A method for determining thermal–structural behavior of a heat shield was developed by heat shield continuum simulation with a truss and shear web network. Application methods, mechanical fastener development, and material use for joint and gap filling are discussed. Recommendations are made for material performance enhancement and further development and testing. R.N.A.

N65-24847*# Emerson Electric Co., St. Louis, Mo. Electronics and Space Div.
PERFORMANCE EVALUATION OF "THERMO-LAG" MATERIAL FOR ENTRY HEAT PROTECTION OF ADVANCED MANNED SPACECRAFT. VOL. 2: THERMAL INVESTIGATIONS Final Report, 1 Oct. 1962–31 Jan. 1964
28 Feb. 1964 319 p refs *Its* Rept.-1675, Vol. 2
(Contract NAS9-877)
(NASA-CR-65010) CFSTI: HC $7.00/MF $1.75

Detailed descriptions are presented of the thermal properties, the thermal performance characteristics, and the behavior of T-500 thermostatic, subliming, heat shield material in the space environment. Experimental results of the program were intensively evaluated for the derivation of basic parameters defining the ablation mechanism. This information was used to establish an IBM computer program for rapid prediction of heat shield material requirements for a given sequence of thermal environments and material characteristics. N.E.A.

N65-24848*# Emerson Electric Co., St. Louis, Mo. Electronics and Space Div.
PERFORMANCE EVALUATION OF "THERMO-LAG" MATERIAL FOR ENTRY HEAT PROTECTION OF ADVANCED MANNED SPACECRAFT. VOL. 3: STRUCTURAL INVESTIGATIONS Final Report, 1 Oct. 1962–31 Jan. 1964
28 Feb. 1964 370 p refs *Its* Rept.-1675, Vol. 3
(Contract NAS9-877)
(NASA-CR-65024) CFSTI: HC $7.00/MF $2.00

The mechanical properties of the T-500 material were determined over a temperature range of −150° F to approximately 400° F. Equations were developed for flat, cylindrical, and spherical panels for the calculations of stresses reasonably removed from a free edge due to a thermal loading environment. In addition to slab stress analyses, an approximating method to simulate a heat shield continuum with a truss and shear web network was used to analyze the conditions near a free edge of the heat shield. Throughout the structural analysis only those thermal loading conditions typical of the mission phases occurring between ascent and entry were investigated. Also discussed, was the extent to which the viscoelastic behavior of T-500 should be considered. Elastic analysis results of slab stresses in a large, flat, composite panel free of external restraints subjected to a temperature gradient were compared to a viscoelastic analysis. G.G.

N65-24849*# Emerson Electric Co., St. Louis, Mo. Electronics and Space Div.
PERFORMANCE EVALUATION OF "THERMO-LAG" MATERIAL FOR ENTRY HEAT PROTECTION OF ADVANCED MANNED SPACECRAFT. VOL. 4: BLISTER INVESTIGATIONS Final Report, 1 Oct. 1962–31 Jan. 1964
28 Feb. 1964 96 p refs *Its* Rept.-1675, Vol. 4
(Contract NAS9-877)
(NASA-CR-65025) CFSTI: HC $3.00/MF $0.75

The cause of blistering of sprayed THERMO-LAG T-500 material along the sidewalls of hemispherical cone models tested in an air-arc plasmajet on 10 December 1962 was investigated. A chemical analysis was made of blistered specimens, showing a nonhomogeneous concentration of salt. Since several components of THERMO-LAG T-500 have a sedimentation tendency, improper spraying techniques could have caused layers more concentrated in salt to be covered by layers more concentrated in resin. Further testing of prepared models indicated that the spray technique was the cause for blistering of the material. As a result of this study, the following corrective measures are now being adapted to eliminate the cause of blistering: use of recirculatory spray equipment for application of material and application of photomicrographs as a material control measure. Author

N65-24971# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
PRESSURE AND HEAT TRANSFER MEASUREMENTS ON 1/45th SCALE SPACE FERRY IN GRUMMAN HYPERSONIC SHOCK TUNNEL AT M = 14 AND 19
Harold Hopkins and Thomas M. Lacinski Nov. 1964 22 p refs
(RM-249)

The results of pressure and heat transfer measurements on a 1/45th scale model space ferry in a hypersonic shock tunnel at Mach numbers 14 and 19 are presented. Because the model was constructed of a soft material the pressure transducers experienced and responded to a large amount of surface distortion. This, plus the acceleration signal picked up by each gage, made it necessary to make two runs per angle of attack. All heat transfer and pressure data were reduced using free stream conditions at the leading edge of the model and are presented in tables. Heat transfer rates expressed in terms of q(Btu/ft^2-sec) and pressures reduced to pressure coefficients are tabulated. Schlieren photographs at Mach 14 are included. R.N.A.

N65-24974*# Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Engine Lab.
V/STOL PLENUM CHAMBER COMBUSTION RESEARCH STUDY, PHASE I Final Report
Lawrence Maggitti 28 Apr. 1965 42 p
(NASA Order-121)
(NASA-CR-63093; NAEC-AEL-1797) CFSTI: HC $1.00/MF $0.50

Analytical and experimental research for the design of efficient combustion systems operating in the fan duct of a turbofan engine for V/STOL consisted of an investigation into the requirements for plenum chamber burning. Experiments with commercial and experimental combustion systems were also conducted. Conclusions were: (1) A combustion system within which the combustion gases are turned through an angle makes best use of the available space in a typical turbofan engine. (2) An annular or tubular can-type combustor is the most suitable. (3) The optimum cross-sectional area of a tubular can combustor for low-pressure loss in this application is about 60% of the maximum cross-sectional area of the outer housing. (4) The optimum combustion efficiency and space heat release rate will not necessarily be reached with the same combustor size as that required for low-pressure loss. (5) Swirl inducers are essential for good combustion. (6) Enlargement of the total air admission area may improve pressure loss. (7) A can-type combustion system operates with 5% to 6% low-pressure loss in the environment of a fan discharge plenum. G.G.

N65-24990*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF COMPOSITION AND DENSITY ON THE ABLATIVE PERFORMANCE OF PHENOLIC-NYLON
Robert T. Swann, William D. Brewer, and Ronald K. Clark [1965] 28 p refs Presented at 8th Natl. Meeting of the Soc. of Aerospace Mater. and Process Engr., San Francisco, 25–28 May 1965
(NASA-TM-X-56486) CFSTI: HC $2.00/MF $0.50

Results are presented from an experimental study of the effects of composition and density on the ablative performance of phenolic-nylon. Maximum effectiveness is obtained with densities of 25 to 30 lb/ft^3, but thermochemical performance is not a strong function of either composition or density. Char spallation is observed under certain conditions, and this form of removal is most severe with high nylon content and/or low density. Author

N65-24996*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
RADIANT HEATING SIMULATION Final Report
T. K. Pugmire and R. W. Liebermann 3 May 1965 136 p refs
(Contract NAS9-3507)
(NASA-CR-65023; RAD-TR-65-6) CFSTI: HC $4.00/MF $1.00

Techniques and requirements for radiant heating simulation encountered by manned spacecraft during reentry are defined. The characterization and definition of the radiant heating environment are given. Data reduction procedures for shock tube radiation data were improved. The arc-column diagnostics technique was used to estimate radiative fluxes. Difficulty was encountered in relating environment parameters to simulation requirements because of information and data voids. Several radiant sources and their performance characteristics were evaluated and the results tabulated. R.N.A.

N65-25008*# General Applied Science Labs., Inc., Westbury, N. Y.
EXPERIMENTAL RESULTS FOR THERMAL IGNITION OF HYDROGEN IN A SUPERSONIC VISCOUS FLOW Technical Report No. 404
James Dunn Dec. 1963 57 p refs
(Contract NAS8-2686)
(NASA-CR-62926) CFSTI: HC $3.00/MF $0.50

Results of a wind-tunnel program to determine ignition characteristics of hydrogen vented from a supersonic or hypersonic launch vehicle are reported. Hydrogen gas was vented into the boundary layer of a two-dimensional Mach 3 flow with 6-psia static pressure and for a range of stagnation temperatures. The experimental results provide a correlation of the onset of combustion with the thermodynamic properties of the flow field and also with ignition characteristics associated with surface irregularities or protuberances. Author

N65-25175# United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering Div.
A METHOD OF REPRESENTING BURNOUT DATA IN TWO PHASE HEAT TRANSFER FOR UNIFORMLY HEATED ROUND TUBES
G. F. Hewitt Nov. 1964 28 p refs
(AERE-R-4613) HMSO: 4s

Burnout data can be represented by plotting the fraction of the liquid that is evaporated before burnout takes place against the channel length over which the enthalpy of the fluid exceeds that of saturated water (i.e., the 'boiling length'). Using burnout data, this method of plotting is developed into a simple graphical correlation covering the effects of diameter, mass velocity, and pressure for water. The correlation is then compared with other data, including recent data for Freon. Author

N65-25211# Army Missile Command, Huntsville, Ala. Structures and Mechanics Lab.
SOLUTION OF TRANSIENT HEAT TRANSFER PROBLEMS FOR FLAT PLATES, CYLINDERS, AND SPHERES BY FINITE-DIFFERENCE METHODS
W. G. Burleson and R. Eppes, Jr. 15 Mar. 1965 33 p refs
(RS-TR-65-1; AD-461662)

Presented in this report are finite-difference (forward) heat-transfer equations applicable to transient, radial heat flow in spheres and cylinders and applicable to transient, one-dimensional heat flow in flat plates. By very minor manipulations, a single heat-transfer procedure can easily be utilized to determine transient heat flow in all three basic structure configurations. For each skin configuration the accuracy of the finite-difference procedure, compared with exact analytical methods, depends on optimum selection of the calculation time increment and the incremental distance between temperature nodes in relation to the material thermal properties and on the closeness of the approximate temperature gradients to the true gradients. Author

N65-25244*# National Bureau of Standards, Boulder, Colo.
AVAILABLE LOW TEMPERATURE THERMOCOUPLE INFORMATION AND SERVICES
L. L. Sparks and R. L. Powell 15 Feb. 1965 20 p refs
(NASA Order R-45)
(NASA-CR-63149; NBS-8750) CFSTI: HC $1.00/MF $0.50

Standard tables of voltage vs temperature for 10 thermocouple pairs frequently used at low temperatures are maintained by the Cryogenic Data Center of the National Bureau of Standards. These tables contain interim values which will be useful until national NBS, ASTM, and ASA tables are established for cryogenic temperatures. Also, material, ISA designations, temperature ranges of the data, and literature references are shown. R.W.H.

N65-25261# Purdue Univ., Lafayette, Ind. Jet Propulsion Center
AN INVESTIGATION ON THE ENERGY TRANSFER IN A TUBE ARC HEATER, PART II Final Technical Report
David J. Norton and S. N. B. Murthy Wright-Patterson AFB, Ohio, ARL, Mar. 1965 84 p refs
(Contract AF 33(657)-10933)
(ARL-65-54; AD-615462)

The object was to develop information for designing tube-arc heaters that operate in the inlet flow regime. A simplified analysis is presented for estimating the performance of a tube arc under prescribed inlet conditions and power input level. The analysis assumes that the mass flux distribution in the flow is essentially constant along the tube, but it takes into account the radial shift of the streamlines due to energy transfer. The gas flowing through the tube arc is assumed to have the same thermodynamic and transport properties as helium. The computer program is described, for an IBM 7090 digital computer, for solving (numerically) the governing equations so that the enthalpy profiles, the velocity profiles, and the electric field can be determined for given input conditions of ampere level, tube geometry, and mass flux distribution. The results are presented in the form of design charts for constant area tube-arcs operating over different ranges of the aforementioned variables. Author

N65-25266*# National Bureau of Standards, Washington, D. C.
VAPORIZATION OF THERMIONIC REFRACTORY MATERIALS Fourteenth Status Report, 1 Dec. 1964–28 Feb. 1965
E. R. Plante 28 Feb. 1965 5 p refs
(NASA Order R-57)
(NASA-CR-63188; NBS-8670) CFSTI: HC $1.00/MF $0.50

A third series of measurements on the rate of sublimation of rhenium in the microbalance apparatus again showed differences in the window and prism correction factors of somewhat less than $5.7 \times 10^{-6} K^{-1}$ corresponding to differences in temperature of about 42° at 2700° K. An attempt to identify the source of contamination was made but yielded unsatisfactory results. Examination of the residuals from the least squares treatment of the series II and III data established that there was some change in the window and prism correction factor during the vapor pressure measurements. A series of measurements at about 2650° K for seven experiments of 20-minutes duration each, with a total weight loss of 1900 micrograms, did not produce any change in the window calibration and no change was predicted by the data obtained. The tentative second and third law heats from these four series were calculated. G.G.

N65-25307# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
COMBUSTION OF AMMONIUM PERCHLORATE SPHERES IN A FLOWING GASEOUS FUEL
Marcel Barrère and Lionel Nadaud 1964 50 p refs Presented at the 10th Intern. Symp. on Combust., Cambridge, 17–21 Aug. 1964
(ONERA-TP-113(1964))

The combustion of ammonium perchlorate spheres in flowing gaseous fuel is studied in conditions similar to those found in burning solid propellant in rocket motors. The theoretical aspect of the study is based on the following model: a decomposition flame near the surface and a diffusion flame surrounding the decomposition flame are admitted. Results show that the diffusion flame alone controls the sphere combustion rate. An experimental study is made of the combustion rate of compressed ammonium perchlorate spheres. The studied parameters are the gas nature, the velocity of the gaseous fuel, and pressure. It is found that the rates are determined by the equation $d^2 = d_0^2 - Kt$ for propane and ammonia, and by $d^3 = d_0^3 - Kt$ for hydrogen, either pure or diluted into nitrogen. Author

N65-25335# Joint Publications Research Service, Washington, D. C.
THE PHENOMENON OF COOLING APPLIED IN SCIENCE AND INDUSTRY
Louis Rey 11 Jun. 1965 9 p Transl. into ENGLISH from Tekhn. Molodezhi (Moscow), no. 3, 1965 p 14–16
(JPRS-30568; TT-65-31244) CFSTI: $1.00

Low temperatures are used to preserve a balance in the changing living mass; three methods utilized are refrigeration, freezing, and lyophilization. An organism in a state of hypothermia develops increased resistance to many noxious effects of the outer medium. Also, hypothermia has aided in the attainment of great achievements in the field of medicine and is frequently applied therapeutically in the treatment of severe traumas and conditions of shock. The correct application of low temperatures will suspend the vital activities of the organism temporarily, with subsequent complete resuscitation. However, some chemical reactions do take place in the cells that are deprived of oxygen by the temporary suspension of vital functions caused by cooling to +15° and 0°. For this reason, the duration of clinical death must be limited to a brief period of time. R.W.H.

N65-25352# Royal Aircraft Establishment, Farnborough (England).
CONSIDERATIONS ON KINETIC HEATING SIMULATION THROUGH SKIN TEMPERATURE CONTROL
D. J. Mills London, Min. of Aviation, Oct. 1963 31 p refs
(RAE-TN-STRUCT-342)

Simulation of the flight kinetic heating and cooling phases through skin temperature control is discussed theoretically, bearing in mind the need of high reliability for long periods in fatigue tests. Basic control elements are taken to be those already in use in the kinetic heating system maintaining equality between thermal flux in flight and laboratory. Environmental influence, system damping and nonlinear effects are considered together with such problems as interchannel coupling and the feasibility of time sharing one element among several channels. A nonintegrating control system is shown feasible; the cooling phase is shown to present the most critical design problem and to require addition of a simple correcting network. Author

N65-25363# European Space Research Organization, Paris (France).
THERMAL ENVIRONMENT IN SPACE
L. A. Husain [1964] 21 p refs Presented at the European Space Res. Organ. Summer School, Oxford, 28 Aug. 1964

The nature of factors contributing to the thermal environment experienced by satellites in space is discussed, e.g., heat sink, solar and earth radiation. The contribution of these factors to the thermal balance is examined. Author

N65-25508# United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering Div.
BURNOUT AND FILM FLOW IN THE EVAPORATION OF WATER IN TUBES
G. F. Hewitt, H. A. Kearsey, P. M. C. Lacey, and D. J. Pulling Mar. 1965 60 p refs
(AERE-R-4864)

Earlier studies of film dryout on a heated rod in an annulus showed burnout to coincide with a simple reduction of the exit film flow rate to zero. The present studies show a very similar pattern of behavior within a heated tube fed with subcooled water and arranged so that film flow at the end could be drawn off and measured. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N65-24492*# National Aeronautics and Space Administration, Washington, D. C.
SCIENCE EDUCATION IN THE SPACE AGE
Frederick B. Tuttle Nov. 1964 117 p refs Proc. of a natl. conf. conducted at the NASA Western Operations Office, Los Angeles, 1–4 Jun. 1964 CFSTI: HC $4.00/MF $0.75

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16. THE SPACE AGE SYNDROME OF THE HUMAN MALE Richard H. Brenneman p 70–73

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18. THE NASA POLICY FOR GRANTS AND RESEARCH CONTRACTS WITH INSTITUTIONS OF HIGHER LEARNING John R. Craig p 76

19. SUMMARY REPORT OF ROUND TABLE DISCUSSIONS AND CONFERENCE PROGRAM Arthur L. Costa p 77–85

20. REACTION TO THE 1964 SPACE SCIENCE EDUCATION CONFERENCE Severo Gomez, Lola J. Eriksen, and Allyn J. Waterman p 86–92

21. ACKNOWLEDGMENT AND CONFERENCE ADJOURNMENT James V. Bernardo p 93

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N65-24573# Congress. House. Committee on Science and Astronautics.
NASA AUTHORIZATION FOR FISCAL YEAR 1966, PART 1
Washington, GPO, 1965 338 p Hearings before Comm. on Sci. and Astronautics, 89th Congr., 1st Sess., H.R. 3730, 17–19, 23–24 Feb., 13 Apr. 1965 GPO: $1.00

N65-24574# Congress. House. Committee on Science and Astronautics.
NASA AUTHORIZATION FOR FISCAL YEAR 1966, PART 2
Washington, GPO, 1965 1065 p Hearings before Comm. on Sci. and Astronautics, 89th Congr., 1st Sess., H.R. 3730, 3-4, 11, 16–17 Mar. 1965 GPO: $3.25

N65-24644# Pisa Univ. (Italy).
ON A METHOD FOR THE RAPID DEFINITION AND IMMEDIATE CONTROL OF THE ELEMENTS OF VERTICAL PATHS [SU DI UN METODO PER LA RAPIDA DEFINIZIONE E PER L'IMMEDIATO CONTROLLO DEGLI ELEMENTI DEI RACCORDI VERTICALI]
Luciano Caroti [1964] 11 p refs In ITALIAN Presented at the 4th Natl. Conv. of Traffic Engr., Pistoia, Italy, 29–31 May 1964 *Its* 21st Ser., No. 1050

Geometrical characteristics of highway design are given. Formulas for minimum distance for stopping, passing, and night driving for various vertical curves are considered.
Transl. by P.F.E.

N65-24649# Congress. Senate Committee on Aeronautical and Space Sciences.
NASA AUTHORIZATION FOR FISCAL YEAR 1966
Washington, GPO, 1965 97 p Report of Comm. on Aeron. and Space Sci., H.R. 7717, 89th Congr., 1st Sess. *Its* Rept. No. 188

N65-24652# Air Force Academy, Colo.
OUTER SPACE, SIXTH AIR FORCE ACADEMY ASSEMBLY, APRIL 1–4, 1964 Final Report
[1964] 96 p Assembly co-sponsored by Am. Assembly, Columbia Univ.

This final report reviews the discussions of the participants in the Sixth Air Force Academy Assembly on outer space. It was concluded that achievements in space are technically feasible in the areas of improved communications, weather and geodetic satellites, interplanetary probes, manned orbiting laboratories, and a manned landing on the moon; that military intelligence and reconnaissance will become more effective due to space exploration; and that the economic implications of the space program will stimulate the overall economy. It was felt that the space program might enhance our international position. G.G.

N65-24697# Joint Publications Research Service, Washington, D. C.
THE MOST IMPORTANT ACHIEVEMENTS IN THE REALM OF NATURAL AND SOCIAL SCIENCES DURING 1964
N. M. Sisakyan 3 Jun. 1965 151 p refs Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 3, Mar. 1965 p 11–119
(JPRS-30398; TT-65-31155) CFSTI: $4.00

Research centered on the principle problems of mathematics, physics, chemistry, and biology, in order to form the necessary theoretical basis for technical progress. Discussed are: *Physico-Technical and Mathematical Sciences*—mathematics, nuclear physics, general and applied physics, physico-technical problems of energy resources, mechanics and control processes, and earth sciences; *Cybernetics; Chemical and Biological Sciences*—chemistry, biochemistry, biophysics, and chemistry of physiologically active compounds, human and animal physiology, and general biology; *Social Sciences*—philosophical sciences, legal sciences, economics, historical sciences, history of literature, and linguistics; *Development of Problems in Methods of Scientific Research;* and *International Scientific Contact.* G.G.

N65-24752# Virginia Polytechnic Inst., Blacksburg.
A MILITARY TRUCK-TRANSPORT MODEL
H. J. Charlton Fort Eustis, Va., Army Transportation Res. Comm., May 1965 27 p refs
(Grant DA-AMC-44-177-63-G8)
(USATRECOM-TR-64-51; AD-615482)

This report is an application of the radiation transport theory to ground logistics supply. It evaluates effectiveness of a supply system subject to attrition due to enemy fire, harassment and other causes of failure to carry out the logistics mission toward forward areas. Author

N65-24818# System Development Corp., Santa Monica, Calif.
THE INDEPENDENCE OF INHERENT AMBIGUITY FROM COMPLEMENTEDNESS AMONG CONTEXT FREE LANGUAGES Scientific Report No. 1
T. Hibbard and J. Ullian 10 Nov. 1964 14 p refs
(Contract AF 19(628)-3418)
(TM-738/010/00; AFCRL-65-37; AD-613290)

Call a context free language unambiguous if it is not inherently ambiguous. In the absence of evidence to the contrary, the suspicion has arisen that the unambiguous languages might be those with context-free complements. The two theorems presented here lay the suspicion to rest by providing (1) an inherently ambiguous language with context-free complement and (2) an unambiguous language without context-free complement. This establishes the independence of inherent ambiguity from complementedness among the context-free languages. Author

N65-24879 Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 181
25 May 1965 90 p Transl. into ENGLISH from Chinese periodicals
(JPRS-30234; TT-65-31075) CFSTI: $3.00

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N65-24925# Smithsonian Institution, Washington, D. C.
ANNUAL REPORT OF THE SMITHSONIAN INSTITUTION, 1962
Washington, GPO [1962] 714 p refs
(Publ.-4518) GPO: $4.75

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23. MAN IN A WORLD OF INSECTS Dwight M. De Long (Ohio State Univ.) p 423–440 ref
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N65-25069# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 180
17 May 1965 74 p refs Transl. into ENGLISH from Chinese periodicals
(JPRS-30107; TT-65-31004) CFSTI: $3.00

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N65-25114# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 179

17 May 1965 100 p refs

(JPRS-30087; TT-65-30994) CFSTI: $4.00

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5. RING OVEN TECHNIQUE FOR THE ISOLATION AND DETECTION OF THORIUM AND ZIRCONIUM Shih-nien Shen, Hsin-tu Keng, and Ting-hsueh K'ang p 45–49 refs (See N65-25117 14-06)

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N65-25125# Lockheed Missiles and Space Co., Palo Alto, Calif. Electronic Sciences Lab.

PROGRESS REPORT, JANUARY–MARCH 1965

W. F. Main [1965] 293 p refs

(LMSC-6-75-65-10)

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2. ATOMIC PHYSICS: RAMSAUER SCATTERING D. E. Golden, H. W. Bandel, and H. Nakano 10 p refs (See N65-25127 14-23)

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N65-25242# Congress. House. Committee on Science and Astronautics.
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Washington, GPO, 1965 1202 p Hearings before the Subcomm. on Sci. and Astronautics, 89th Congr., 1st Session, H.R. 3730 (superseded by H.R. 7717), Mar. 4–26, 1965, Pt. 3, No. 2 GPO: $3.50

The NASA authorization for 1966 contains the hearings before the Subcommittee on Space Science and Applications of the Committee on Science and Astronautics, U.S. House of Representatives. R.W.H.

N65-25465 International Business Machines Corp., Armonk, N. Y.
IBM TECHNICAL DISCLOSURE BULLETIN, VOL. 7, NO. 9, FEBRUARY 1965
R. W. Fletcher et al [1965] 135 p ref

Abstracts are presented under these headings: *Acoustics; Chemical; Electrical; Fluid Mechanics; General; High-Vacuum Electron Emission; Light; Magnetic; Mechanical; Metallurgical; Semiconductor;* and *Thermal*. Among the technical disclosures discussed was a miniature delay line, coupling the word lines to the sense lines of a matrix, which provides an effective read-only memory with virtually no signal attenuation. Also, a low temperature method for gas phase etching of semiconductor materials was outlined. Such an etching technique is used to selectively etch given parts of the surface of a semiconductor during the fabrication of planar semiconductor devices. Further, a circuit which provides direct reading of the beta of a transistor under test is described. The circuit compares emitter current to the base current rather than measuring the transistor base current. E.E.B.

N65-25518# Army Research Office, Durham, N. C.
RESEARCH IN PROGRESS, 1964
Nils M. Bengtson [1964] 314 p refs

Annotated reports on the scope and progress of research studies are presented for the following fields: physics, chemistry, mathematics, engineering, and metallurgy and ceramics. G.G.

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